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M.S. Chouhan
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Organic Chemistry
for JEE
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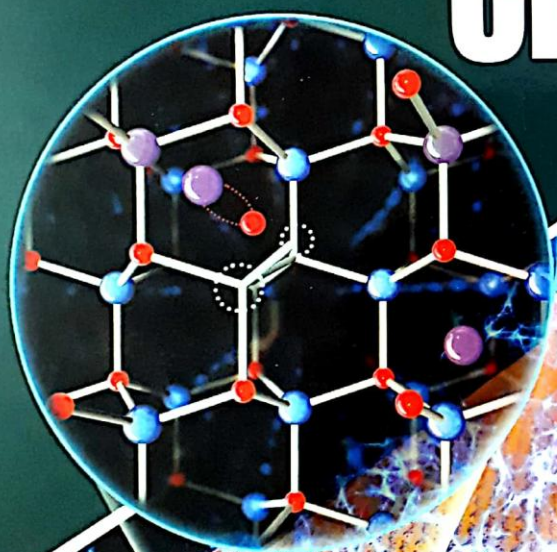
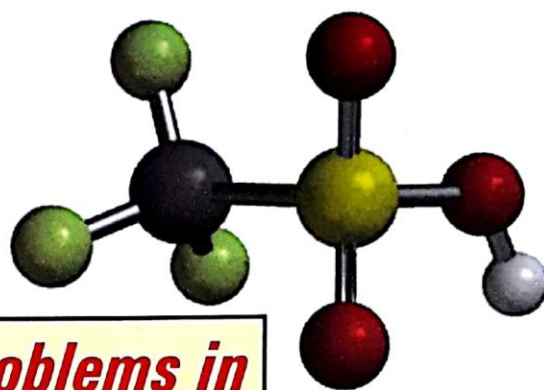

About the Author

Mahendra Singh Chouhan (MSC Sir) is a renowned name in the realm of Organic Chemistry. Through a Chemical Engineer from Mumbai University, his great passion for the subject led him to impart guidance to IIT-JEE aspirants on a regular basis. His in depth knowledge and vast experience has helped innumerable students to achieve their dream of excelling at IIT, JEE and other such tough challenges.

He has launched a website to extend the benefits of his expertise beyond the geographical barriers to all those who dare to dream and seek - **www.iitjeeorganic.com**.

The website provides expert guidance in all the areas of the subject in a most skillful manner. There are quizzes, challenging questions, notes, e-books and videos etc. This website is a complete guide in itself for organic chemistry and has been designed for IIT-JEE aspirants, keeping in mind the various syllabi and CBSE.

Highly recommended for the high flyers.

Advanced Problems in

ORGANIC CHEMISTRY

for
by:

M.S. Chouhan

Director

Vibrant Academy, Kota

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A few words to the JEE Aspirants

Dear JEE aspirants,

I hope that this collection of problems will surely help you during your preparation for JEE. In this book, each chapter consists of two levels :

Level 1 - includes the problems having only one option correct. These problems are based on different facts and their twists.

Level 2 - includes unique approach which may be used to solve the problems altogether different from the prevailing trend followed by JEE. These approaches will undoubtedly help you in the quick revision of the key facts and their applications.

I wish all of you a grand success in the ensuing Joint Entrance Examination. Your valuable suggestions and constructive criticism for the betterment of the book are welcome.

M.S. Chouhan

Preface

It is a matter of great pleasure for me to present the eleventh edition of **"Advanced Problems in Organic Chemistry for JEE"** before JEE aspirants. During my teaching experience, I felt that the facts may be made more and more clear to the students through problematic approach. Although an ocean of material in Organic Chemistry is available with the students, yet the approach to design the problems has been changed in recent years and if one tries to swim in this ocean, it will be a very difficult task. To make the students more familiar with trends and tricks how to solve problems, the present problem book has been presented. In the current scenario of stiff competition especially for JEE, one must be clear that almost all the sincere applicants are well equipped with the facts of subject, yet the winner is one who knows how to use these equipments with accuracy and efficiency. As an experienced teacher, I would like to suggest students three golden rules to score high in Organic Chemistry:

1. Don't get behind
2. Work out a number of problems of different types
3. Revise through short notes / learning chart.

I hope that the present book will cater to the needs of JEE aspirants & as a matter of fact, they will enjoy the present venture and I would feel rewarded if this book is found helpful to the students and teachers in real terms. All attempts have been made to make the book error free however a few misprints may inadvertently creep.

I acknowledge the blessing and support of my mother Smt. Raj Kanwar, father Shri B.S. Chouhan, brother Dr. V.S. Chouhan, my wife and daughter. They inspired me all the time during the preparation of this book.

The support and valuable suggestions from my colleagues especially Mr. N. Avasthi , Mr. V. K. jaiswal, Mr. Nitin Jain, Mr. N.K. Sethia, Mr. Vikash Gupta, Mr. Pankaj Joshi, Dr. S. Kothari, Mr. Vineet Khatri, Mr. Ashish Mishra, Mr. Manish Arora, Mr. Govind Khandelwal, Mr. Rahul Pareek, Mr. Rahul Malav, Mr. Divyesh Tiwari, Mr. Omkar Kelapure, Mr. Kishore Kilani, Mr. Mayank Pareek, Mr. Gurpreet Singh, Mr. Yogesh Jain, Madam Anjana Kamal , Mr. Aneet Choudhary, Mr. Shaliwahan Singh Rathore, Mr. Akshay Chaudhary, Mr. Hanuman Sahay, Mrs. Neha Joshi, Mrs. Neetu Jha, Mr. Kamlesh Gupta and Mr. Kumud Ranjan are highly acknowledged. I also pay my sincere thanks to all the esteemed members of **M/s Shri Balaji Publications** in bringing out this book in such a nice form.

In the last, constructive criticism and valuable suggestions from the readers are most welcome to make the book more useful.

M.S. CHOUHAN

Contents

LEARNING CHART (AROMATIC COMPOUND)
BENZENE
Aniline
Tribromo Aniline
Benzamide
Ammonium Benzoate
Benzoic Acid
Toluene or Methyl Benzene
Benzyl Chloride
Sod. Benzoate
Trinitro Toluene (Explosive) (TNT)
Benzene
Cyclo Hexane
Phenol
Picric acid
Benzaldehyde
Cumene
Benzene Sulphonic acid
Nitro Benzene
m-Dinitro Benzene
Sulphanilamide
Benzene Diazoniumchloride
Chloro Benzene
Cyno Benzene
Salicylic acid
Acetophenone
Benzoyl Chloride
Tribromo-phenol (white ppt.)
Salicylaldehyde
Toluene (Clemmenson reduction)
Benzoic acid
(Esterification) reaction
(Industrial Preparation of Phenol)
maleic anhydride

LEARNING CHART (ALIPHATIC)
Methane
Ethane
Ethyl bromide
Ethyl alcohol
Acetaldehyde
Acetic acid
Sodium acetate
Benzene
Propanamine
propane nitrile
Propanoic acid
Propanoyl chloride
Propanamide
Ethyl amine
Ethylisonitrile
Acetylene
Ethylene
Glycol.
Glyoxal
Oxalic acid
Ethylene bromide
Ethylene Cyanide
Vinyl bromide
Succinic acid
Succinic anhydride
Dibromo Succinic acid
Ethanal
Ethyl alcohol
Acetone
(Aldol-condensation)
Darzen - Process
(Clemmensen reduction)
(Wolf-Kishner reduction)
(Iodoform rxn.)
Cyclic Acetal
Tollen's reagent
(Cannizaro rxn.)
Williamson ether synthesis
Baeyer villiger oxidation

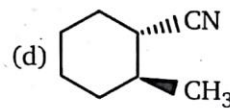
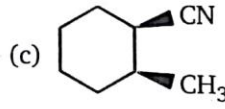
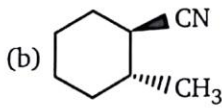
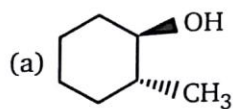
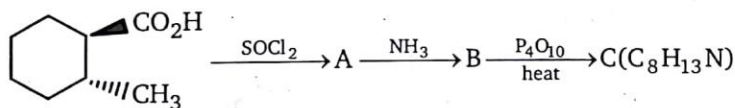
LEARNING CHART OF PHENOL (A TO Z)
Prepration of Phenol
Dow process
+ NaOH
623 K
300 atm
ONa
HCl
SO3H
(i) NaOH,350°C
(ii) H+
Benzene Sulphonic acid
NH2
NaNO2
+ HCl
N2Cl
H3O+
Δ
Industrial prepration of phenol
CUMENE HYDROPEROXIDE
50 – 90°C
Test of phenolic OH group
(1)
conc. H2SO4
–H2O
NaOH
Pink colour
Phenophthalein Indicator
(2) 6C6H5OH + FeCl3 → [Fe(C6H5O6)]-3 + 3HCl + 3H+
neutral sol.
violet complex
(3) Liebermann nitroso Test
NaNO2
H2SO4,0°C
p-Nitrosophenol
deep green or blue colour
dilution
Red colour
COOH
OCOCH3
(Aspirin)
Acetylation
CH3COCl
or
(CH3CO)2O
OH
COOH
(1) NaOH
(2) CO2, H+
SO3H
conc.
H2SO4
PHENOL
OR
CARBOLIC ACID
Zn dust
+ ZnO
(1) O3
(2) Zn + H2O
CHO
CHO
Na2Cr2O7,H+
(Benzoquinone)
Oxidation reaction
Reaction of Phenol
Dil HNO3
NO2
Conc. HNO3
2,4,6-trinitrophenol (PICRIC ACID)
Br2 in CS2
Br
Br2 water
CHCl3 + aq . NaOH
H+
CHO
Reimer tiemann formylation
Na/NaOH
ONa
NaOH
R — X(SN2)
X = Cl, Br, I, -SO3R
OR
(R – C)2O Or R – C – Cl
O – C – R
PhN2Cl
mild basic
HO
N = N –Ph
(Coupling reaction)
CCl4 + NaOH
(Reimer tiemann carboxylation)
H2,Ni
160°C
(Catalytic reduction)

9 CARBOXYLIC ACID AND THEIR DERIVATIVES

LEVEL- 1

1. Identify C in the following sequence of reactions :

(cyclohexane with wedged CO_2H and hashed CH_3) $\xrightarrow{SOCl_2} A \xrightarrow{NH_3} B \xrightarrow[\text{heat}]{P_4O_{10}} C(C_8H_{13}N)$

(a) cyclohexane with wedged OH and hashed CH_3
(b) cyclohexane with wedged CN and hashed CH_3
(c) cyclohexane with wedged CN and wedged CH_3
(d) cyclohexane with hashed CN and wedged CH_3

2. Saponification (basic hydrolysis) of $C_6H_5C(=O)$●CH_3 will yield :

[● = mass – 18 isotope of oxygen]

(a) $C_6H_5-C(=O)-$●$^-$ + H●CH_3

(b) $C_6H_5-C(=O)-O^-$ + H●CH_3

(c) $C_6H_5C(=O)O^-$ + H●$^-$

(d) $C_6H_5C(=$●$)O^-$ + $HOCH_3$

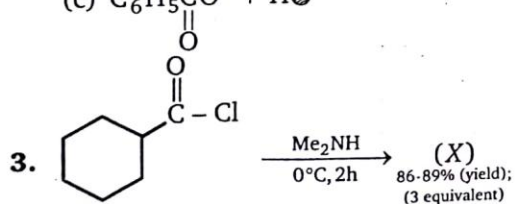
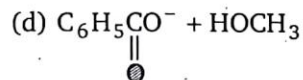
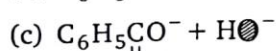
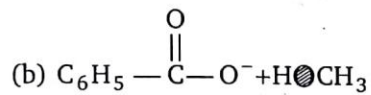
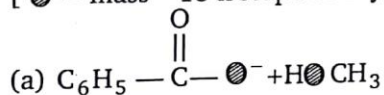
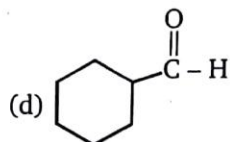
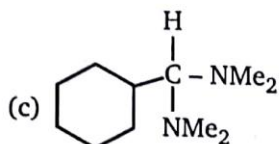
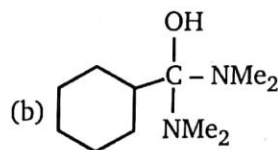
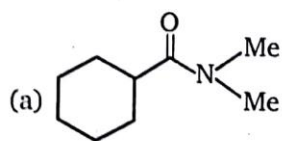
3. (cyclohexyl–C(=O)–Cl) $\xrightarrow[0°C,\ 2h]{Me_2NH}$ (X)
86-89% (yield);
(3 equivalent)

Product (*X*) of the reaction is :

(a) Cyclohexyl–C(=O)–N(Me)(Me)

(b) Cyclohexyl–C(OH)(NMe$_2$)–NMe$_2$

(c) Cyclohexyl–CH(NMe$_2$)–NMe$_2$

(d) Cyclohexyl–C(=O)–H

4. Which of the following is the correct order of decarboxylation of β-keto carboxylate anion ?

(a) $R-C(=O)-CH(F)-C(=O)O^-$ (b) $R-C(=O)-CH(Cl)-C(=O)O^-$ (c) $R-C(=O)-CH(NO_2)-C(=O)O^-$ (d) $R-C(=O)-CH(CN)-C(=O)O^-$

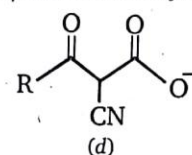
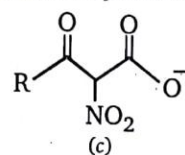
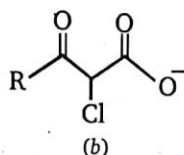
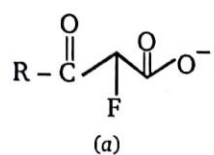
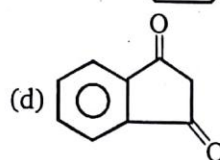
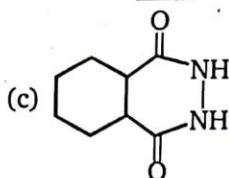
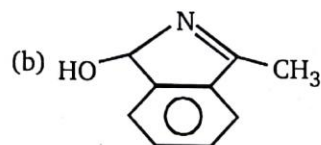
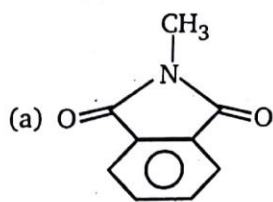
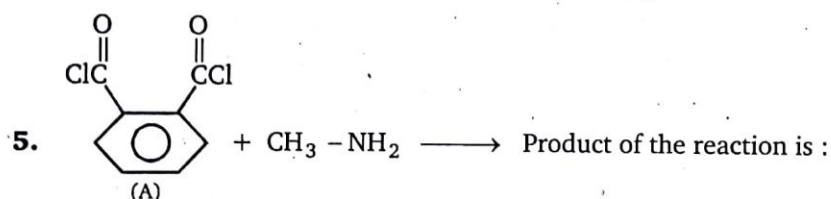
(a) $a > b > c > d$ (b) $c > d > a > b$ (c) $c > d > b > a$ (d) $d > c > a > b$

5. (A) [benzene-1,2-di(COCl)] + CH_3-NH_2 ⟶ Product of the reaction is :

(a) N-methylphthalimide (O=C–N(CH$_3$)–C=O fused to benzene)

(b) HO–CH–N=C(CH$_3$) ring fused to benzene

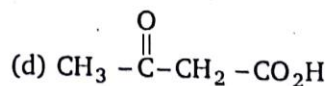
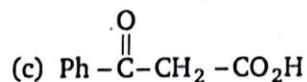
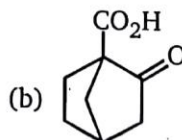
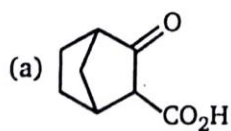
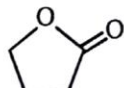
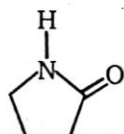
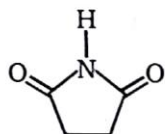
(c) Cyclohexane fused with C(=O)–NH–NH–C(=O) ring

(d) Benzene fused with C(=O)–CH$_2$–C(=O) ring (indane-1,3-dione)

6. Which β-keto acid shown will not undergo decarboxylation ?

(a) Bicyclic ketone with O and CO_2H

(b) Bicyclic ketone with bridgehead CO_2H and O

(c) $Ph-\overset{O}{\overset{\|}{C}}-CH_2-CO_2H$

(d) $CH_3-\overset{O}{\overset{\|}{C}}-CH_2-CO_2H$

7. Choose the response that matches the correct functional group classification with the following group of structural formulas.

(a) Anhydride	Lactam	Lactone
(b) Lactam	Imide	Lactone
(c) Imide	Lactone	Anhydride
(d) Imide	Lactam	Lactone

8. $\xrightarrow[(2)\ H^+,\ H_2O]{(1)\ Et-Li(3-eq.)}$ (*P*) (65% yield) ; Product (*P*) of the reaction is :

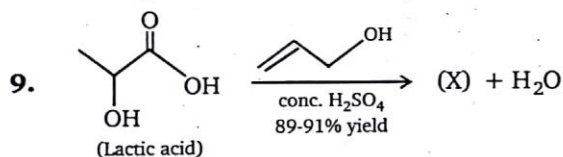
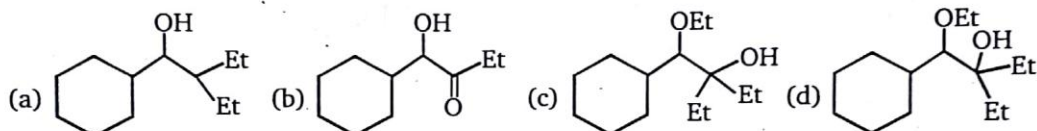
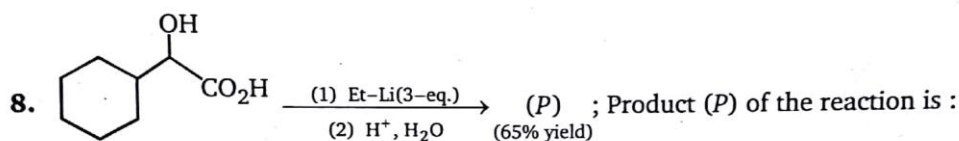
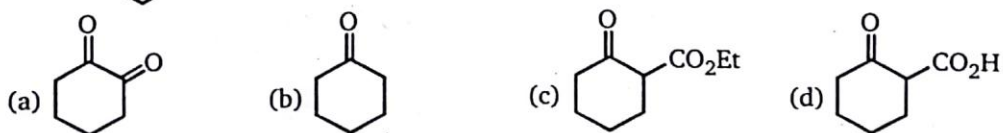
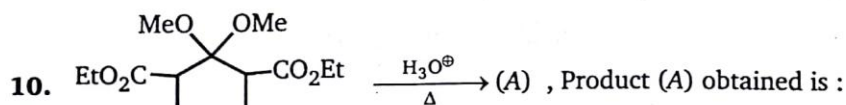
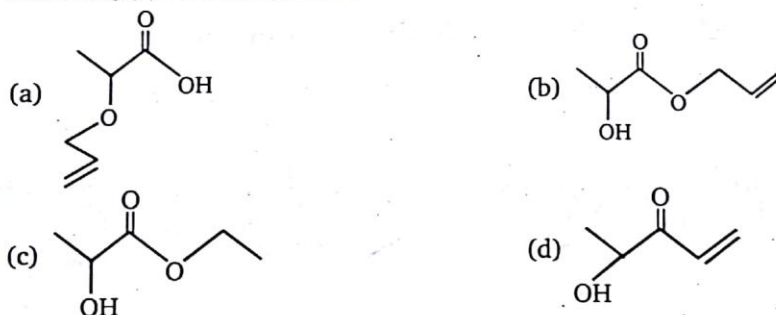
(a) (b) (c) (d)

9. (Lactic acid) $\xrightarrow[\text{conc. } H_2SO_4,\ 89\text{-}91\%\ \text{yield}]{}$ (X) + H_2O

Product (X) of the reaction is :

(a) (b) (c) (d)

10. $\xrightarrow[\Delta]{H_3O^{\oplus}}$ (*A*) , Product (*A*) obtained is :

(a) (b) (c) (d)

11. Which of the following acid on heating gives geometrical isomers as a product ?

(a) $CH_3-CH(OH)-CO_2H$

(b) 3-chlorocyclobutane-1,1-dicarboxylic acid (cyclobutane ring with two CO_2H groups on one carbon and Cl on the opposite carbon)

(c) $CH_3-CH(OH)-CH_2-CO_2H$

(d) All of these

12. Phthalic anhydride $\xrightarrow{MeOH} A \xrightarrow{PCl_3} B \xrightarrow{MeNH_2} C$; Product (C) of the reaction is :

(a) benzene ring with ortho $-\overset{O}{\overset{\|}{C}}-Cl$ and $-\overset{O}{\overset{\|}{C}}-NH-Me$

(b) benzene ring with ortho $-\overset{O}{\overset{\|}{C}}-NH-Me$ and $-\overset{O}{\overset{\|}{C}}-O-Me$

(c) benzene ring with ortho $-\overset{O}{\overset{\|}{C}}-NH_2$ and $-\overset{O}{\overset{\|}{C}}-OMe$

(d) benzene ring with ortho $-\overset{O}{\overset{\|}{C}}-Cl$ and $-\overset{O}{\overset{\|}{C}}-NH_2$

13. Phthalic anhydride $\xrightarrow{LiAlH_4} A \xrightarrow{PCC} B \xrightarrow{NH_2-NH_2} C$, Product (C) is :

(a) benzene fused ring with $-\overset{O}{\overset{\|}{C}}-NH-NH-\overset{O}{\overset{\|}{C}}-$

(b) benzene fused ring with $-CH=N-N=CH-$

(c) benzene fused ring with $-C(OH)=N-N=C(OH)-$

(d) benzene ring with ortho NH_2, NH_2

14. $CH_3-CH(Cl)-CH(Cl)-COO^-$ $\xrightarrow{-CO_2} A \xrightarrow{HCl} B \xrightarrow{aq\ KOH} C$. Product ($C$) is :

(a) $CH_3-CH_2-\overset{O}{\overset{\|}{C}}-H$

(b) $CH_3-CH(OH)-CH_2-CH_2-OH$

(c) $CH_3-\overset{O}{\overset{\|}{C}}-H$

(d) $CH_3-\overset{O}{\overset{\|}{C}}-CH_3$

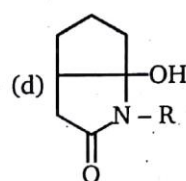
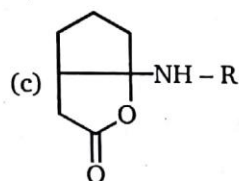
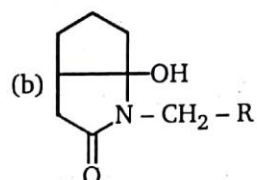
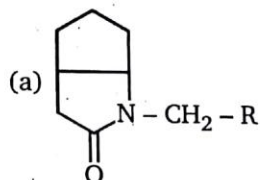
15. (bicyclic lactone with –Cl at ring junction) $+ R-CH_2-NH_2 \xrightarrow[THF]{K_2CO_3} (A)$ (71%)

In above reaction identify major product (*A*) of the reaction:

(a) N – CH_2 – R (bicyclic lactam)

(b) –OH, N – CH_2 – R

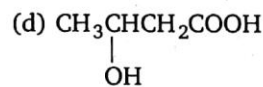
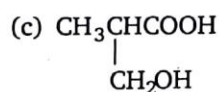
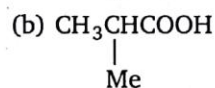
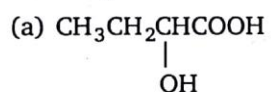
(c) –NH – R (lactone)

(d) –OH, N – R

16. An optically active compound '*X*' has molecular formula $C_4H_8O_3$. It evolves CO_2 with $NaHCO_3$. '*X*' reacts with $LiAlH_4$ to give an achiral compound. '*X*' is :

(a) $CH_3CH_2CH(OH)COOH$

(b) $CH_3CH(Me)COOH$

(c) $CH_3CH(CH_2OH)COOH$

(d) $CH_3CH(OH)CH_2COOH$

17. $CH_3-\overset{O}{\overset{\|}{C}}-O-CH_2-CH_3 + H-●^- \longrightarrow$ (● $= O^{18}$) One of the product of the reaction is :

(a) $CH_3-\overset{O}{\overset{\|}{C}}-O-H$

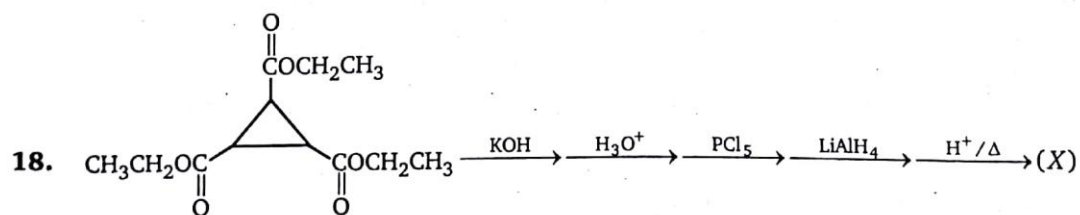
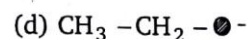
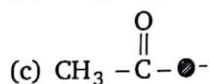
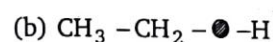
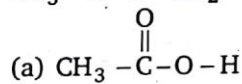
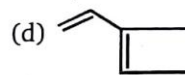
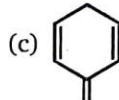
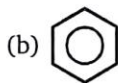
(b) $CH_3-CH_2-●-H$

(c) $CH_3-\overset{O}{\overset{\|}{C}}-●^-$

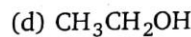
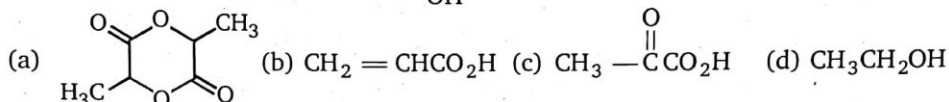
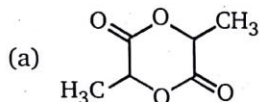
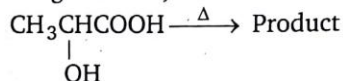
(d) $CH_3-CH_2-●^-$

18.

Product (X) is :

(a) (b) (c) (d)

19. Identify final product in the following reaction;

$$CH_3\underset{\substack{|\\ OH}}{C}HCOOH \xrightarrow{\Delta} \text{Product}$$

(a) cyclic dilactide with CH_3 and H_3C substituents (b) $CH_2=CHCO_2H$ (c) $CH_3-\overset{\substack{O\\ \|}}{C}CO_2H$ (d) CH_3CH_2OH

20. Select the final product from this sequence of reactions.

Acetoacetic ester $\xrightarrow{NaOEt} \xrightarrow{CH_3I} \xrightarrow{NaOEt} \xrightarrow{CH_3CH_2CH_2Br}$

(a) $H_3C-\overset{\substack{O\\ \|}}{C}-\overset{\substack{CH_3\\ |}}{\underset{\substack{|\\ CH_2CH_2CH_3}}{C}}-COOC_2H_5$

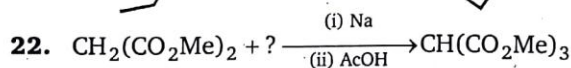
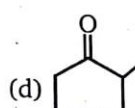
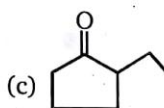
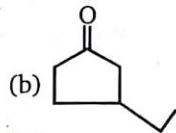
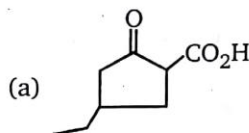
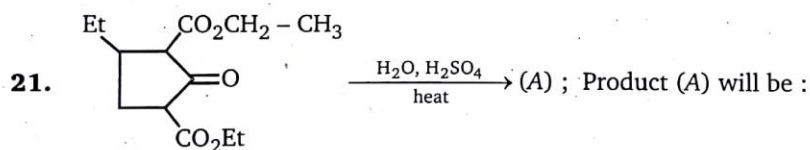
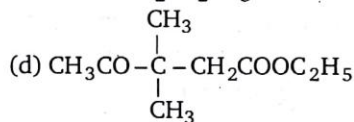
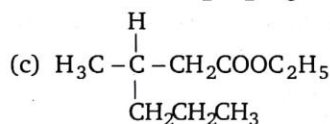
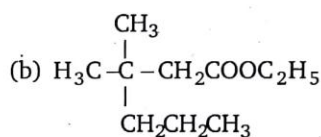
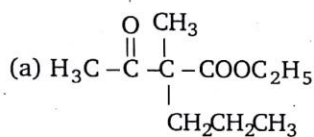
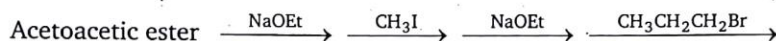
(b) $H_3C-\overset{\substack{CH_3\\ |}}{\underset{\substack{|\\ CH_2CH_2CH_3}}{C}}-CH_2COOC_2H_5$

(c) $H_3C-\overset{\substack{H\\ |}}{\underset{\substack{|\\ CH_2CH_2CH_3}}{C}}-CH_2COOC_2H_5$

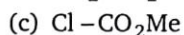
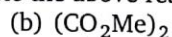
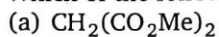
(d) $CH_3CO-\overset{\substack{CH_3\\ |}}{\underset{\substack{|\\ CH_3}}{C}}-CH_2COOC_2H_5$

21.

$\rightarrow (A)$; Product (A) will be :

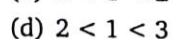
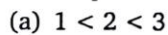
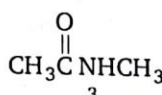
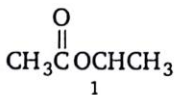
22. $CH_2(CO_2Me)_2 + ? \xrightarrow[\text{(ii) AcOH}]{\text{(i) Na}} CH(CO_2Me)_3$

Which of the following reactants will complete the above reaction ?

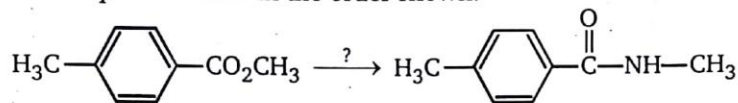
(a) $CH_2(CO_2Me)_2$ (b) $(CO_2Me)_2$

(c) $Cl-CO_2Me$ (d) $COCl_2$

23. Arrange the following in order of increasing reactivity (least $\longrightarrow$ most) towards nucleophile

$CH_3\overset{\substack{O\\ \|}}{C}OCHCH_3$ (1) $CH_3\overset{\substack{O\\ \|}}{C}Cl$ (2) $CH_3\overset{\substack{O\\ \|}}{C}NHCH_3$ (3)

(a) $1 < 2 < 3$ (b) $3 < 1 < 2$

(c) $1 < 3 < 2$ (d) $2 < 1 < 3$

24. Choose the best sequence of reactions for transformation given. Semicolons indicate separate reaction steps to be used in the order shown.

$$H_3C-C_6H_4-CO_2CH_3 \xrightarrow{?} H_3C-C_6H_4-\overset{O}{\overset{\|}{C}}-NH-CH_3$$

(a) H_3O^+; $SOCl_2$; CH_3NH_2

(b) HO^-/H_2O; PBr_3; Mg; CO_2; H_3O^-; $SOCl_2$; CH_3NH_2

(c) $LiAlH_4$; H_2O; HBr; Mg; CO_2; H_3O^+; $SOCl_2$; CH_3NH_2

(d) None of these would yield the desired product

25. A key step in the hydrolysis of acetamide in aqueous acid proceeds by nucleophilic addition of :

(a) H_3O^+ to $CH_3\overset{O}{\overset{\|}{C}}NH_2$

(b) H_2O to $CH_3\overset{^+OH}{\overset{\|}{C}}NH_2$

(c) H_3O^+ to $CH_3\overset{^+OH}{\overset{\|}{C}}NH_2$

(d) HO^- to $CH_3\overset{^+OH}{\overset{\|}{C}}NH_2$

26. Which reaction is not possible for acetic anhydride ?

(a) $(CH_3\overset{O}{\overset{\|}{C}})_2O + 2HN(CH_3)_2 \longrightarrow CH_3\overset{O}{\overset{\|}{C}}N(CH_3)_2 + CH_3CO_2^- + H_2\overset{+}{N}(CH_3)_2$

(b) $(CH_3\overset{O}{\overset{\|}{C}})_2O + CH_3CH_2OH \longrightarrow CH_3\overset{O}{\overset{\|}{C}}OCH_2CH_3 + CH_3CO_2H$

(c) $(CH_3\overset{O}{\overset{\|}{C}})_2O + C_6H_6 \xrightarrow{AlCl_3} CH_3\overset{O}{\overset{\|}{C}}C_6H_5 + CH_3CO_2H$

(d) $(CH_3\overset{O}{\overset{\|}{C}})_2O + NaCl \longrightarrow CH_3\overset{O}{\overset{\|}{C}}Cl + CH_3CO_2^-Na^+$

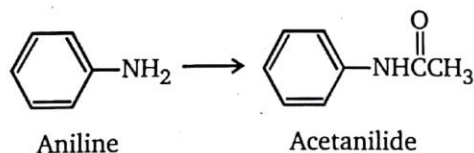
27. All but one of the following compounds react with aniline to give acetanilide. Which one does not?

$$C_6H_5-NH_2 \longrightarrow C_6H_5-NH\overset{O}{\overset{\|}{C}}CH_3$$

Aniline — Acetanilide

(a) $CH_3\overset{O}{\overset{\|}{C}}-Cl$

(b) $H_3C-\overset{O}{\overset{\|}{C}}-O-\overset{O}{\overset{\|}{C}}-CH_3$

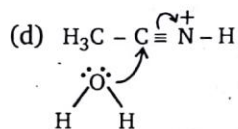
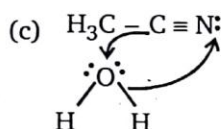
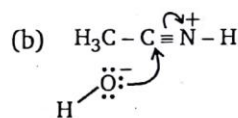
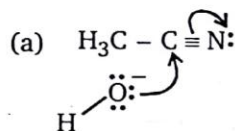
(c) $CH_3\overset{O}{\overset{\|}{C}}-H$

(d) $C_6H_5-O\overset{O}{\overset{\|}{C}}CH_3$

28. Which of the following best describes the nucleophilic addition step in the acid-catalyzed hydrolysis of acetonitrile (CH_3CN) ?

(a)

(b) $H_3C-C\equiv\overset{+}{N}-H$, $H-\ddot{O}:^-$

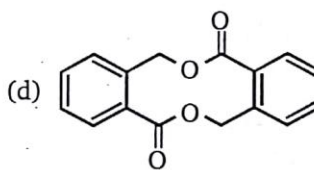
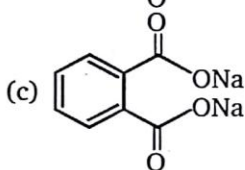
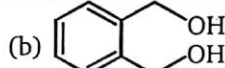
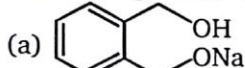
(c) $H_3C-C\equiv N:$, $H_2\ddot{O}:$

(d) $H_3C-C\equiv\overset{+}{N}-H$, $H_2\ddot{O}:$

29. The major product expected, when Phthalamide is treated with NaOH, is :

(a) OH, ONa, O

(b) OH, OH

(c) ONa, ONa, O, O

(d) O, O, O, O

30. Which of following acid remains unaffected on heating ?

(a) malonic acid
(b) maleic acid
(c) Fumaric acid
(d) Succinic acid

31. Br–(n)–Br + $CH_2(CO_2Et)_2 \xrightarrow[EtOH]{NaOEt}$ cyclic product

At which value of n the formation of six membered ring takes place ?

(a) $n = 2$ (b) $n = 3$ (c) $n = 5$ (d) $n = 6$

32. O, N, O $\xrightarrow[H_2O]{LiAlH_4 (excess)}$ Product of the reaction is :

(a) CH_2OH, CH_2OH

(b) NH_2

(c) N

(d) OH, N, OH

33. CO_2H, CO_2H, CO_2H $\xrightarrow[(-CO_2)]{\Delta} \xrightarrow[(-H_2O)]{\Delta}$, Product of the reaction is :

(a) *cis*-anhydride
(b) *trans*--anhydride
(c) both (a) & (b)
(d) mono-basic acid

34. $p\text{-}CH_3C_6H_4\text{-}CO\text{-}CH_2CH_2\text{-}CO_2H \xrightarrow[\text{(ii) EtMgBr} \quad \text{(iii) } H^+/\Delta]{\text{(i) EtOH, HCl}} (A)$

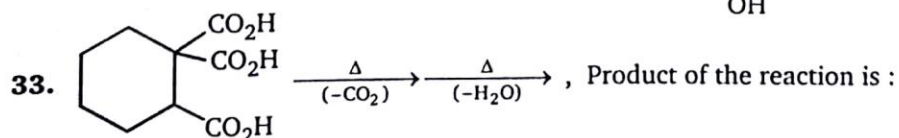
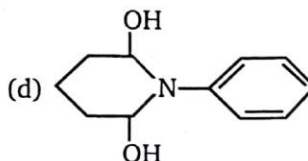
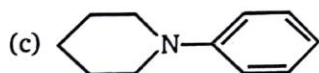
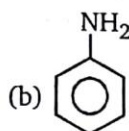
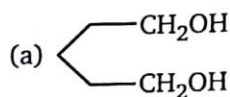
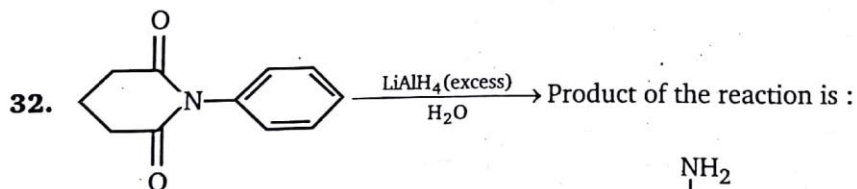
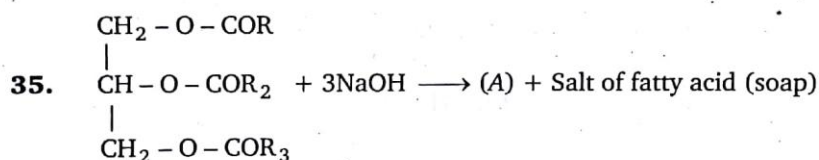
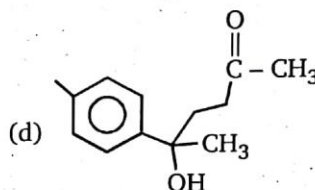
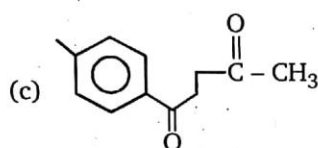
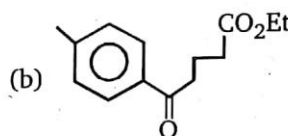
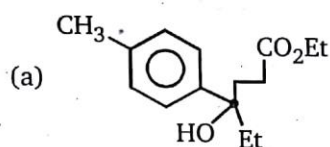
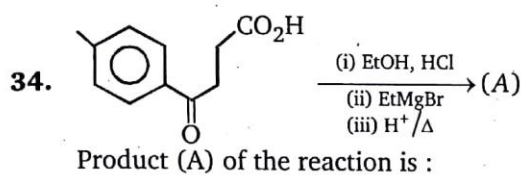
Product (A) of the reaction is :

(a) $p\text{-}CH_3C_6H_4\text{-}C(OH)(Et)\text{-}CH_2CH_2\text{-}CO_2Et$

(b) $p\text{-}CH_3C_6H_4\text{-}CO\text{-}CH_2CH_2\text{-}CO_2Et$

(c) $p\text{-}CH_3C_6H_4\text{-}CO\text{-}CH_2CH_2\text{-}CO\text{-}CH_3$

(d) $p\text{-}CH_3C_6H_4\text{-}C(OH)(CH_3)\text{-}CH_2CH_2\text{-}CO\text{-}CH_3$

35. $CH_2-O-COR$ / $CH-O-COR_2$ / $CH_2-O-COR_3$ $+ 3NaOH \longrightarrow (A) +$ Salt of fatty acid (soap)

Product (A) of the reaction is :

(a) Ethylene glycol
(b) Glycerol
(c) Glyceryltrinitrate (explosive)
(d) Cumene hydrogen peroxide

36. $CH_3-\underset{\underset{(d)}{Et}}{CH}-OAc \xrightarrow{HO^-}$ Product of the reaction is :

(d=dextro rotatory)

(a) $CH_3-\underset{(d)}{\overset{Et}{CH}}-OH$
(b) $CH_3-\underset{\underset{(l)}{Et}}{CH}-OH$
(c) $CH_3-\underset{\underset{(d)\ \&\ (l)}{Et}}{CH}-OH$
(d) $CH_3-\underset{CH_3}{C}=CH_2$

37. $Ph-CH=CH-\overset{O}{\overset{||}{C}}-O-H \xrightarrow[\text{(ii) } NH_2\text{-cyclopropyl}]{\text{(i) } SOCl_2} (A)$; Product (A) of the reaction is :

(a) $Ph-CH=CH-\overset{O}{\overset{||}{C}}-CH_2-NH-$cyclopropyl

(b) $Ph-CH=CH-\overset{O}{\overset{||}{C}}-NH-$cyclopropyl

(c) $Ph-CH=CH-\overset{O}{\overset{||}{C}}-H$

(d) $Ph-CH=CH-NH-$cyclopropyl

38. $Ph-\overset{O}{\overset{||}{C}}-Cl$ + (Morpholine) $\longrightarrow$ (A) (Major) ; Identify the product (A).

(a) $Ph-\overset{O}{\overset{||}{C}}-\overset{\oplus}{O}$ (ring) N – H

(b) $Ph-\overset{O}{\overset{||}{C}}-N$ (ring) O

(c) $Ph-\overset{O}{\overset{||}{C}}-N$ (ring) O

(d) $Ph-\overset{O}{\overset{||}{C}}-NH_2$

39. (methyl acrylate, OMe) + (propanol, OH) $\overset{\text{Conc. HCl}}{\rightleftharpoons}$ (propyl acrylate) + MeOH

Above reaction is an example of :

(a) Esterification (b) Saponification

(c) Hydrolysis (d) Trans Esterification

40. Which of the following is an intermediate formed in the reaction shown below ?

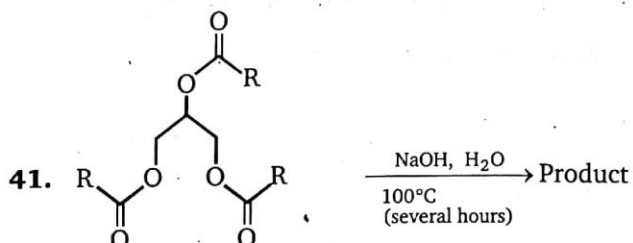
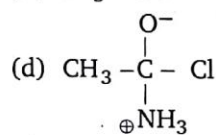
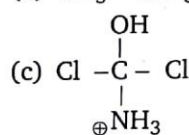
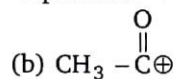
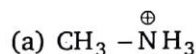
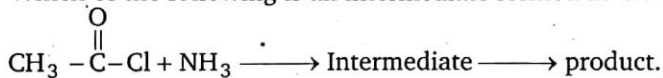
$CH_3-\overset{O}{\overset{||}{C}}-Cl + NH_3 \longrightarrow$ Intermediate $\longrightarrow$ product.

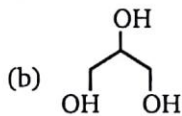
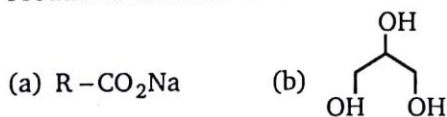
(a) $CH_3-\overset{\oplus}{N}H_3$

(b) $CH_3-\overset{O}{\overset{||}{C}}\oplus$

(c) $Cl-\underset{\oplus NH_3}{\overset{OH}{\overset{|}{\underset{|}{C}}}}-Cl$

(d) $CH_3-\underset{\oplus NH_3}{\overset{O^-}{\overset{|}{\underset{|}{C}}}}-Cl$

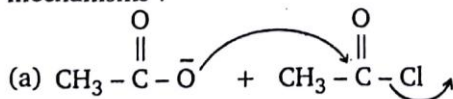
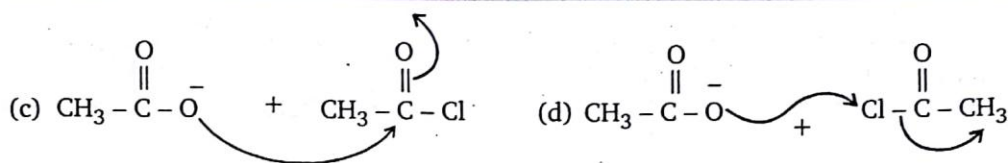
41. (Triglyceride, R groups) $\xrightarrow[\substack{100°C \\ \text{(several hours)}}]{NaOH,\ H_2O}$ Product

(Principal component of coconut oil.)

Product is obtained in the above reaction is :

(a) $R-CO_2Na$ (b) (glycerol: OH, OH, OH) (c) Both (a) and (b) (d) None of these

42. The reaction of sodium acetate with acetyl chloride proceeds through which of the following mechanisms ?

(a) $CH_3-\overset{O}{\overset{||}{C}}-\bar{O}$ + $CH_3-\overset{O}{\overset{||}{C}}-Cl$

(b) $CH_3-\overset{O}{\overset{||}{C}}-\bar{O}$ + $CH_3-\overset{O}{\overset{||}{C}}-Cl$

(c) $CH_3-\overset{O}{\overset{||}{C}}-O^-$ + $CH_3-\overset{O}{\overset{||}{C}}-Cl$ (d) $CH_3-\overset{O}{\overset{||}{C}}-O^-$ + $Cl-\overset{O}{\overset{||}{C}}-CH_3$

43. Which is the major product of the following reaction ?

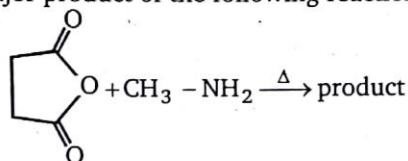
$$CH_3-\overset{O}{\overset{||}{C}}-Cl \xrightarrow{H_2S} \text{product}$$

(a) $CH_3-\underset{SH}{\overset{OH}{C}}-Cl$ (b) $CH_3-\overset{O}{\overset{||}{C}}-SH$ (c) $CH_3-\overset{S}{\overset{||}{C}}-Cl$ (d) $CH_3-\overset{O}{\overset{||}{C}}-S-\overset{O}{\overset{||}{C}}-CH_3$

44. Which is the major product of the following reaction ?

(succinic anhydride) O + $CH_3-NH_2 \xrightarrow{\Delta}$ product

(a) N − CH_3 (N-methylsuccinimide) (b) N − CH_3 (imino lactone)

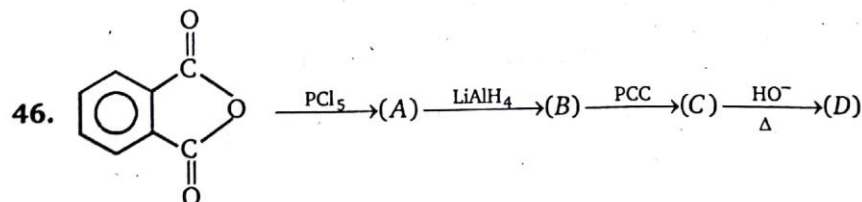
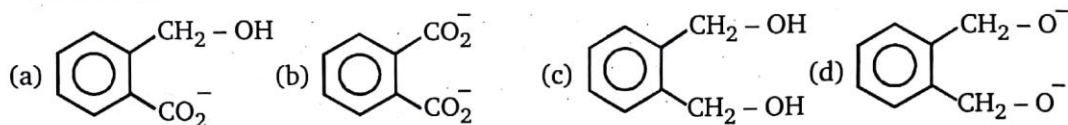
(c) $HO-\overset{O}{\overset{||}{C}}-CH_2-CH_2-\overset{O}{\overset{||}{C}}-NH-CH_3$

(d) $CH_3-NH-\overset{O}{\overset{||}{C}}-CH_2-CH_2-\overset{O}{\overset{||}{C}}-NH-CH_3$

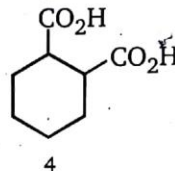
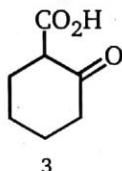
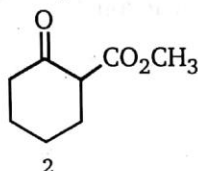
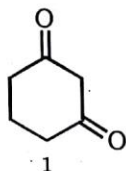
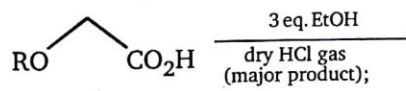
45. Ethanoic acid + 3-methyl-1-butanol $\underset{\text{traces } H_2SO_4}{\rightleftharpoons}$ (*A*); Compound (*A*) is :

(a) isopropyl acetate (b) 3-methylbutyl acetate

(c) butyl acetate (d) sec-butyl acetate

46. (phthalic anhydride) $\xrightarrow{PCl_5}(A)\xrightarrow{LiAlH_4}(B)\xrightarrow{PCC}(C)\xrightarrow[\Delta]{HO^-}(D)$

(a) benzene ring with CH_2-OH and CO_2^- (b) benzene ring with CO_2^- and CO_2^- (c) benzene ring with CH_2-OH and CH_2-OH (d) benzene ring with CH_2-O^- and CH_2-O^-

47. Which of the following compounds will undergo decarboxylation on heating ?

1: cyclohexane-1,3-dione; 2: 2-(CO_2CH_3)cyclohexanone; 3: 2-oxocyclohexane with CO_2H; 4: cyclohexane-1,2-dicarboxylic acid (CO_2H, CO_2H)

(a) 2 and 3 (b) 3 and 4 (c) 3 only (d) 1 and 4

48. Which one of the following is not an intermediate in the generally accepted mechanism for the reaction shown below ?

$$CF_3\overset{O}{\overset{||}{C}}OH + CH_3\underset{OH}{\underset{|}{C}H}CH_3 \xrightarrow{H_2SO_4} CF_3\overset{O}{\overset{||}{C}}.O\underset{CH_3}{\underset{|}{C}H}CH_3 + H_2O$$

(a) $CF_3\overset{^{+}\ddot{O}H}{\overset{||}{C}}-\ddot{O}H$

(b) $CF_3\overset{:\ddot{O}:^-}{\underset{:\ddot{O}H}{\overset{|}{\underset{|}{C}}}}-\ddot{O}CH(CH_3)_2$

(c) $CF_3\overset{:\ddot{O}H}{\underset{^{+}\ddot{O}H_2}{\overset{|}{\underset{|}{C}}}}-\ddot{O}CH(CH_3)_2$

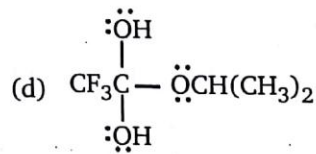
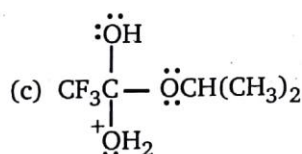
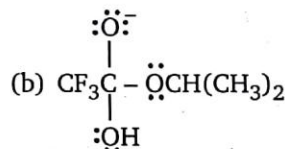
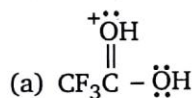
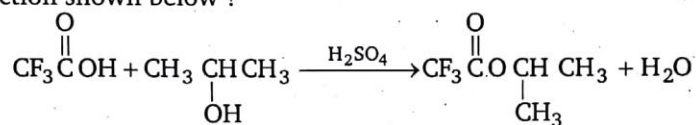
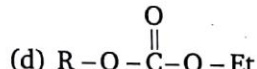
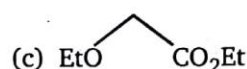
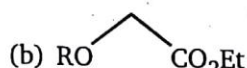
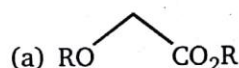
(d) $CF_3\overset{:\ddot{O}H}{\underset{:\ddot{O}H}{\overset{|}{\underset{|}{C}}}}-\ddot{O}CH(CH_3)_2$

49. $RO\diagup\diagdown CO_2H \xrightarrow[\text{dry HCl gas (major product);}]{\text{3 eq. EtOH}} (A)$; Product A is :

(a) $RO\diagup\diagdown CO_2R$

(b) $RO\diagup\diagdown CO_2Et$

(c) $EtO\diagup\diagdown CO_2Et$

(d) $R-O-\overset{O}{\overset{||}{C}}-O-Et$

50. Identify the compound C in the following sequence :

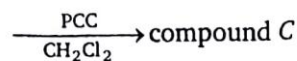
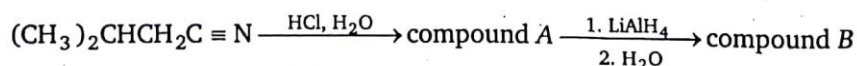
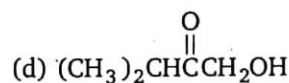
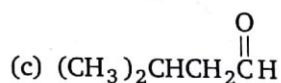
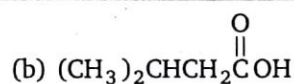
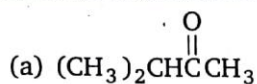
$$(CH_3)_2CHCH_2C\equiv N \xrightarrow{HCl,\ H_2O} \text{compound } A \xrightarrow[2.\ H_2O]{1.\ LiAlH_4} \text{compound } B$$

$$\xrightarrow[CH_2Cl_2]{PCC} \text{compound } C$$

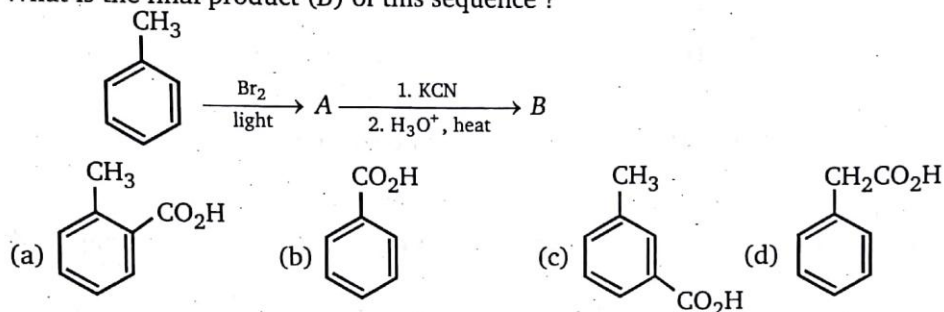
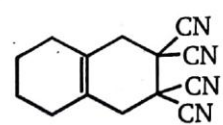
(a) $(CH_3)_2CHCCH_3$ (with C=O)

(b) $(CH_3)_2CHCH_2COH$ (with C=O)

(c) $(CH_3)_2CHCH_2CH$ (with C=O)

(d) $(CH_3)_2CHCCH_2OH$ (with C=O)

51. What is the final product (*B*) of this sequence ?

Toluene ($C_6H_5CH_3$) $\xrightarrow[\text{light}]{Br_2}$ *A* $\xrightarrow[\text{2. } H_3O^+\text{, heat}]{\text{1. KCN}}$ *B*

(a) o-$CH_3C_6H_4CO_2H$ (b) $C_6H_5CO_2H$ (c) m-$CH_3C_6H_4CO_2H$ (d) $C_6H_5CH_2CO_2H$

52. Which of the following undergoes decarboxylation most readily on being heated ?

(a) $C_6H_5COCH_2CH_2COOH$

(b) $C_6H_5CH(COOH)CH_2COCH_2CH_3$

(c) $HOOC{-}C_6H_4{-}CH_2CH_2CH_2COOH$

(d) $C_6H_5CH(COOH)COCH_2CH_2CH_3$

53. What is compound *Z* ?

$CH_3CH_2CH_2Br \xrightarrow{NaCN} X \xrightarrow[\text{heat}]{H_3O^+} Y \xrightarrow[H^+]{CH_3CH_2OH} Z$

(a) $CH_3CH=CHCOH$ (with C=O)

(b) $CH_3CH_2CH_2CH=NOCH_2CH_3$

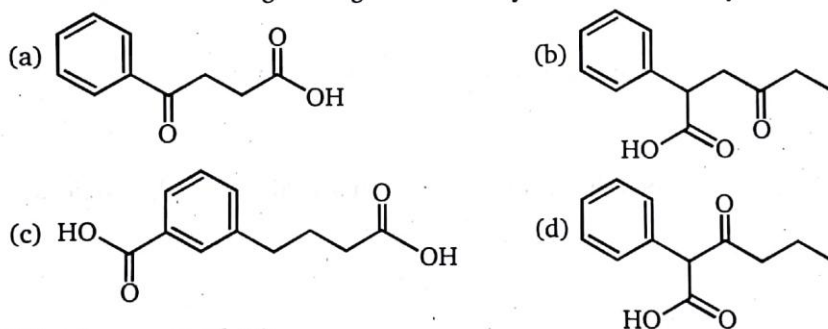
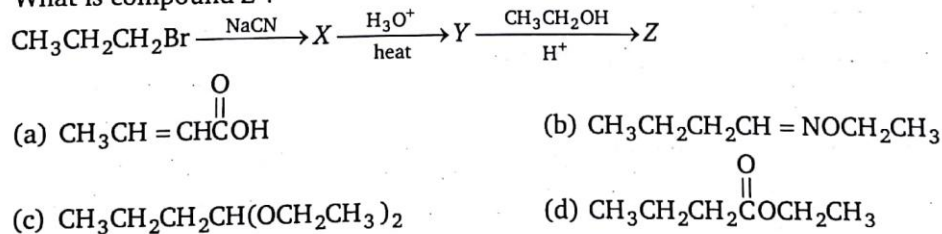
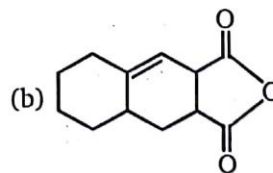
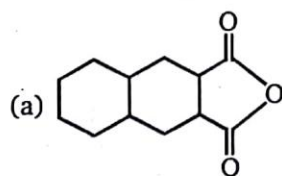
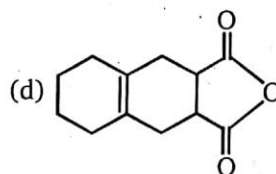
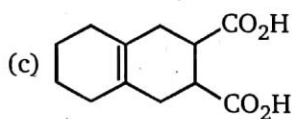
(c) $CH_3CH_2CH_2CH(OCH_2CH_3)_2$

(d) $CH_3CH_2CH_2COCH_2CH_3$ (with C=O)

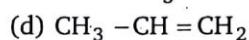
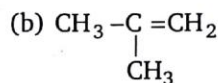
54. (Bicyclic compound with two geminal CN pairs: C(CN)$_2$–C(CN)$_2$) $\xrightarrow{H_3O^{\oplus}/\Delta}$ (*A*); Product (*A*) of the reaction is :

(a) (tricyclic anhydride, saturated)

(b) (tricyclic anhydride, with C=C)

(c) CO_2H CO_2H (d)

55. $CH_3-CH=CH-CH_2-CO_2H \xrightarrow{\Delta} (X)$ (major); Product (X) is :

(a) $CH_3-CH=CH-CH_3$ (b) $CH_3-\underset{\underset{CH_3}{|}}{C}=CH_2$

(c) $CH_3-CH_2-CH=CH_2$ (d) $CH_3-CH=CH_2$

56. $H-O-\overset{\overset{O}{||}}{C}-(CH_2)_n-\overset{\overset{O}{||}}{C}-O-H \xrightarrow{\Delta}$ product, At what value of (n) given compound will not evolve CO_2 gas ?

(a) $n = 5$ (b) $n = 4$ (c) $n = 2$ (d) $n = 1$

57. $\begin{array}{c} CO_2H \\ | \\ (CH_2)_n \\ | \\ CO_2H \end{array}$; If $(n = 4)$ then di-carboxylic acid would be known as :

(a) Malonic acid (b) Succinic acid (c) Adipic acid (d) Oxalic acid

58. $\xrightarrow{2H_2O} (A)$

Product (A) of the above reaction is :

(a) HO, OH, CH_3, CO_2H, CO_2H

(b) O=, OH, CO_2H, CO_2H

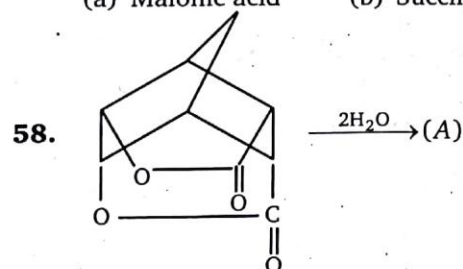
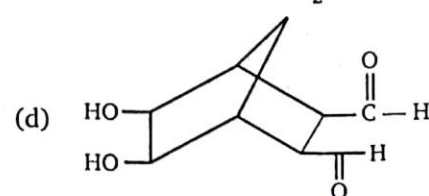
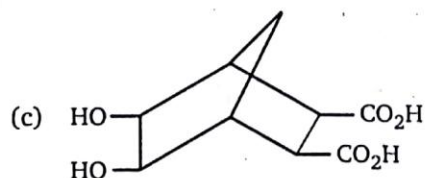
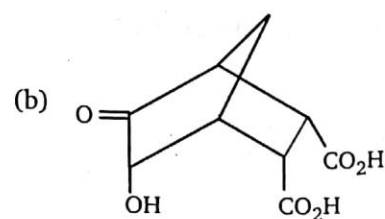
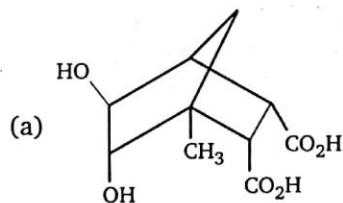
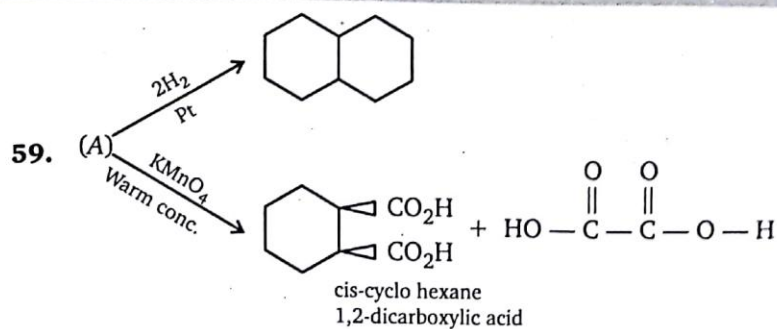
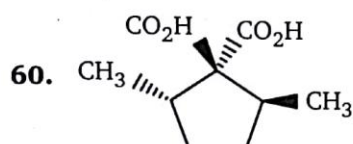
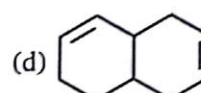
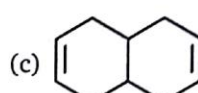
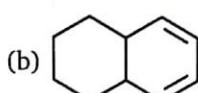
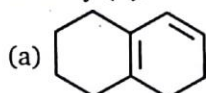
(c) HO, HO, CO_2H, CO_2H

(d) HO, HO, $\overset{O}{\overset{||}{C}}-H$, $\underset{O}{\underset{||}{C}}-H$

59.

Identify (*A*).

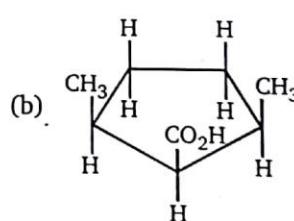
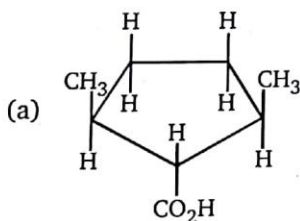
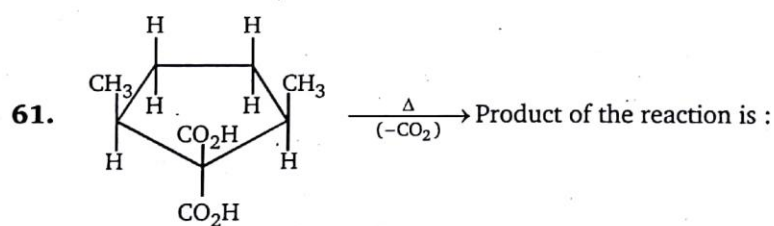
(a) (b) (c) (d)

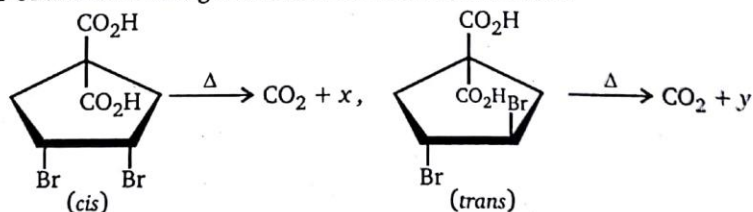
60. CO_2H CO_2H CH_3 CH_3

How many product will be formed when above compound undergo de-carboxylation?

(a) 0 (b) 1 (c) 2 (d) 3

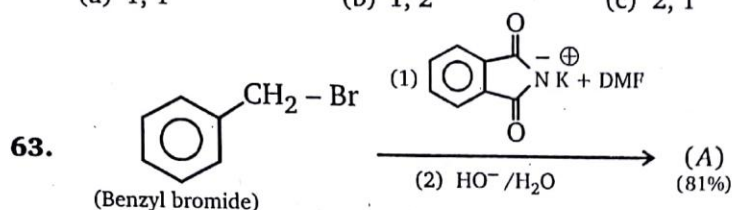
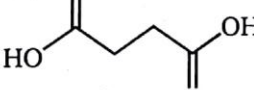
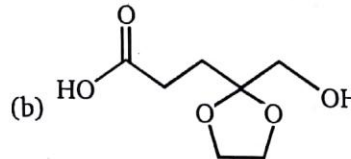
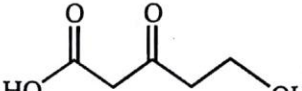
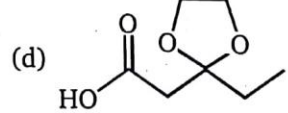
61. $\xrightarrow[(-CO_2)]{\Delta}$ Product of the reaction is :

(a)

(b)

(c) Both (a) and (b) (d) none of these

62. Products obtained in the given reactions are shown below.

The number of possible products for x and y are :

(a) 1, 1 (b) 1, 2 (c) 2, 1 (d) 2, 2

63. (Benzyl bromide) $C_6H_5CH_2-Br \xrightarrow[(2)\ HO^-/H_2O]{(1)\ \text{Potassium phthalimide} + DMF} (A)$ (81%)

Product (A) of the above reaction is :

(a) $Ph-NH_2$ (b) $Ph-CH_2-NH_2$

(c) $Ph-CH_2-NH-CO_2H$ (d) $Ph-CH_2-NH-CHO$

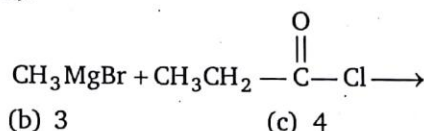
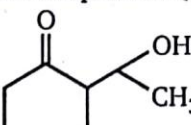
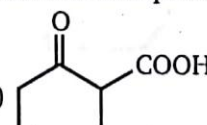
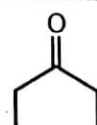
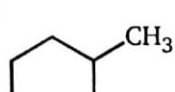
64. Which of the following pair is C_2-epimer ?

(a) *D*-Glucose, *D*-Maltose (b) *D*-Glucose, *D*-Mannose

(c) *D*-Allose, *D*-Ribose (d) *D*-Glucose, *D*-Arabinose

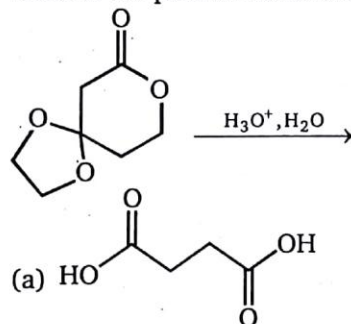
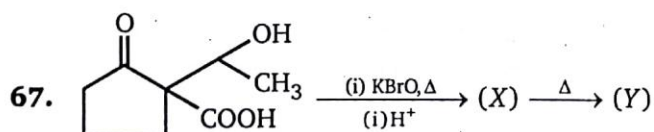
65. Total number of enol possible for the compound formed during given reaction will be (including stereoisomer):

$$CH_3MgBr + CH_3CH_2-\overset{O}{\overset{||}{C}}-Cl \longrightarrow$$

(a) 2 (b) 3 (c) 4 (d) 5

66. What is the product of the following reaction ?

$\xrightarrow{H_3O^+, H_2O}$

(a) (b) (c) (d)

67. $\xrightarrow[(i)\ H^+]{(i)\ KBrO, \Delta} (X) \xrightarrow{\Delta} (Y)$

Hence the product (Y) in the above sequence of reactions, is :

(a) (b) (c) (d)

68. [Structures: 3-methylcyclohexanecarboxamide ($C-NH_2$, CH_3) and 3-ethylcyclohexanecarboxamide ($C-{}^{15}NH_2$, C_2H_5)] $\xrightarrow[\text{(Intramolecular migration)}]{\overset{\ominus}{OH}/Br_2}$ Products are :

(a) 3-methylcyclohexylamine (NH_2, CH_3) and 3-ethylcyclohexylamine (${}^{15}NH_2$, Et)

(b) 3-methylcyclohexylamine (NH_2, CH_3) and 3-ethylcyclohexylamine (${}^{15}NH_2$, Et)

(c) 3-methylcyclohexylamine (NH_2, CH_3) and 3-ethylcyclohexylamine (${}^{15}NH_2$, Et)

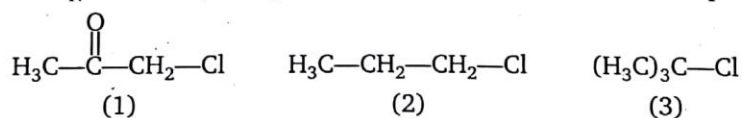
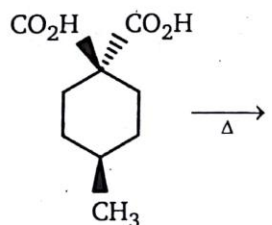
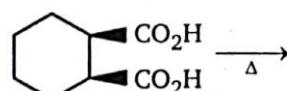
(d) 3-methylcyclohexylamine (${}^{15}NH_2$, CH_3) and 3-ethylcyclohexylamine (NH_2, Et)

69. $CH_3CH_2CH(OH)CH(CH_3)_2 + CH_3COCl \xrightarrow{\text{base}} CH_3CH_2CH(OCOCH_3)CH(CH_3)_2 + HCl$

In the above reaction, if the reactant alcohol is a pure R-isomer the product would.

(a) have configuration inverted at the chiral atom
(b) be a racemic mixture
(c) have the same configuration at the chiral atom
(d) be optically inactive

70. The order of S_N1 reactivity in aqueous acetic acid solution for the compounds

$H_3C-\overset{O}{\overset{\|}{C}}-CH_2-Cl$ (1) $\quad H_3C-CH_2-CH_2-Cl$ (2) $\quad (H_3C)_3C-Cl$ (3)

(a) $1 > 2 > 3$ (b) $1 > 3 > 2$ (c) $3 > 2 > 1$ (d) $3 > 1 > 2$

ANSWERS — LEVEL 1

1.	(b)	**2.**	(b)	**3.**	(a)	**4.**	(c)	**5.**	(a)	**6.**	(b)	**7.**	(d)	**8.**	(b)
9.	(b)	**10.**	(b)	**11.**	(d)	**12.**	(b)	**13.**	(b)	**14.**	(a)	**15.**	(b)	**16.**	(c)
17.	(c)	**18.**	(b)	**19.**	(a)	**20.**	(a)	**21.**	(b)	**22.**	(c)	**23.**	(b)	**24.**	(a)
25.	(b)	**26.**	(d)	**27.**	(c)	**28.**	(d)	**29.**	(c)	**30.**	(c)	**31.**	(b)	**32.**	(c)
33.	(a)	**34.**	(a)	**35.**	(b)	**36.**	(a)	**37.**	(b)	**38.**	(b)	**39.**	(d)	**40.**	(d)
41.	(c)	**42.**	(c)	**43.**	(b)	**44.**	(c)	**45.**	(b)	**46.**	(a)	**47.**	(c)	**48.**	(b)
49.	(b)	**50.**	(c)	**51.**	(d)	**52.**	(d)	**53.**	(d)	**54.**	(d)	**55.**	(c)	**56.**	(c)
57.	(c)	**58.**	(c)	**59.**	(b)	**60.**	(b)	**61.**	(c)	**62.**	(c)	**63.**	(b)	**64.**	(b)
65.	(b)	**66.**	(c)	**67.**	(c)	**68.**	(b)	**69.**	(c)	**70.**	(c)				

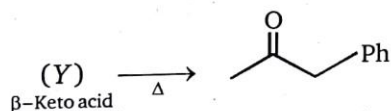
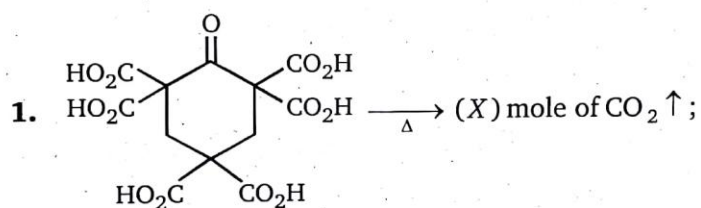
LEVEL-2

1. Match the Column (I) and (II). (Matrix)

Column (I)		Column (II)	
Reaction		**Products formed**	
(a)	CH_3; HO_2C—C—CO_2H; H—C—D; Ph $\xrightarrow{\Delta}$	**(p)**	Diastereomers
(b)	CH_3; HO_2C—C—CO_2H; Et $\xrightarrow{\Delta}$	**(q)**	Racemic mixture
(c)	CO_2H, CO_2H (cyclohexane); CH_3 $\xrightarrow{\Delta}$	**(r)**	Meso compound
(d)	(cyclohexane) CO_2H, CO_2H $\xrightarrow{\Delta}$	**(s)**	CO_2 gas will evolve

SUBJECTIVE PROBLEMS

1. HO_2C, HO_2C, O, CO_2H, CO_2H, HO_2C, CO_2H $\xrightarrow{\Delta}$ (X) mole of $CO_2\uparrow$;

$\underset{\beta\text{-Keto acid}}{(Y)} \xrightarrow{\Delta}$ O, Ph

(Y) is including stereoisomers. Value of $(X+Y)$ will be

ANSWERS — LEVEL 2

1. a – p, s; b – q, s; c – p, s; d – r

Subjective Problems

1. 8

10 AMINES

LEVEL- 1

1. In which of the following reaction cyanide will be obtained as a major product ?

(a) $Ph-\overset{O}{\overset{||}{C}}-CH_3 \xrightarrow[(ii)\ H_3O^+]{(i)\ LiAlH_4}$

(b) $Ph-\overset{O}{\overset{||}{C}}-NH_2 \xrightarrow[Br_2]{NaOH}$

(c) $Ph-\overset{O}{\overset{||}{C}}-NH_2 \xrightarrow{P_4O_{10}}$

(d) $Ph-\overset{O}{\overset{||}{C}}-O-H \xrightarrow{SOCl_2} \xrightarrow{NH_3}$

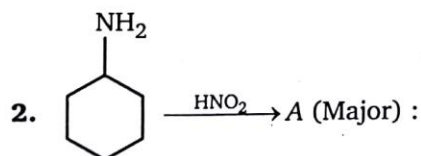
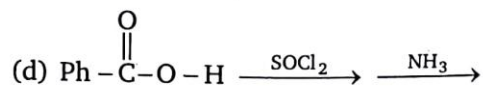
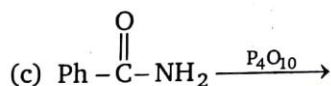
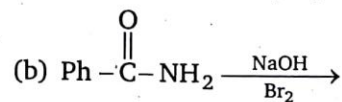
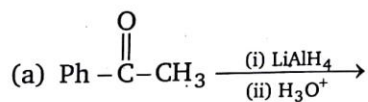
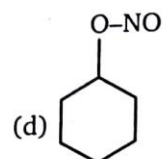
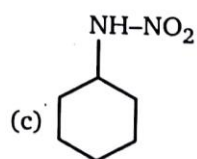
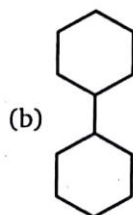
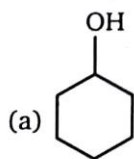
2. $\xrightarrow{HNO_2}$ A (Major) :

Product (A) is :

(a) cyclohexane–OH

(b) cyclohexyl–cyclohexyl

(c) cyclohexane–NH–NO_2

(d) cyclohexane–O–NO

3. Which of the following alkene cannot be prepared by de-amination of n-Bu – NH_2 with $NaNO_2/HCl$? (n-Butyl)

(a) 1-butene (b) *cis*-2-butene (c) *trans*-2-butene (d) Iso-butene

4. Predict the major product P in the following reaction.

OH, Me, Me, Me, NH_2 $\xrightarrow{HNO_2}$ P

(a) O, Me, Me, Me

(b) OH, Me, Me, Me

(c) OH, Me, Me, Me, OH

(d) OH, Me, CH_2, Me

5. NH_2 $\xrightarrow[H_2SO_4]{NaNO_2}$ (A); Product of this reaction is :

(a)

(b)

(c)

(d)

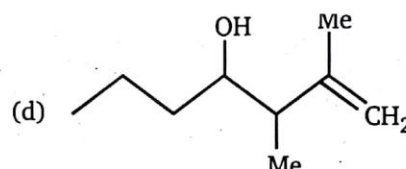
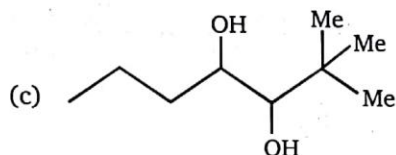
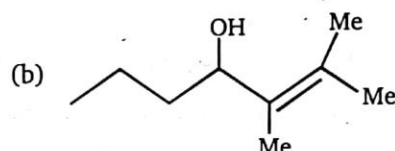
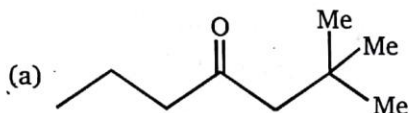
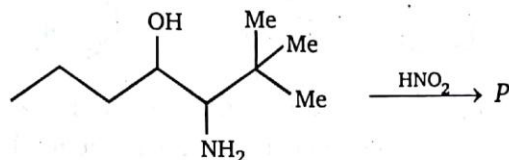
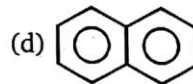
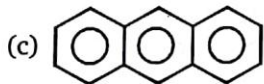
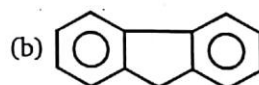
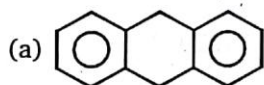
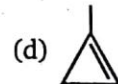
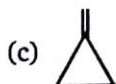
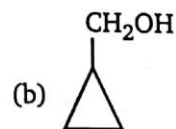
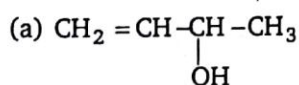
6. CH_2-NH_2 $\xrightarrow{HNO_2}$ (A) + OH + $CH_2=CH-CH_2-CH_2-OH$
48% 47%

A will be :

(a)
$CH_2=CH-CH(OH)-CH_3$

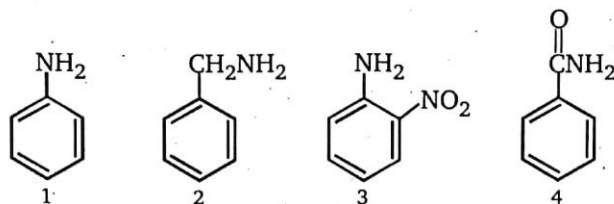
(b)

(c)

(d)

7. Which of the following isomers of C_8H_9NO is the weakest base ?

(a) *o*-Aminoacetophenone (b) *p*-Aminoacetophenone
(c) *m*-Aminoacetophenone (d) Acetanilide

8. Rank the following compounds in order of increasing basic strength. (weakest → strongest) :

1: aniline ($C_6H_5NH_2$); 2: benzylamine ($C_6H_5CH_2NH_2$); 3: o-nitroaniline (NH_2, NO_2); 4: benzamide ($C_6H_5CONH_2$)

(a) $4 < 2 < 1 < 3$ (b) $4 < 3 < 1 < 2$ (c) $4 < 1 < 3 < 2$ (d) $2 < 1 < 3 < 4$

9. Which of the following arylamines will not form a diazonium salt on reaction with sodium nitrite in hydrochloric acid ?

(a) *m*-Ethylaniline (b) *p*-Aminoacetophenone

(c) 4-Chloro-2-nitroaniline (d) *N*-Ethyl-2-methylaniline

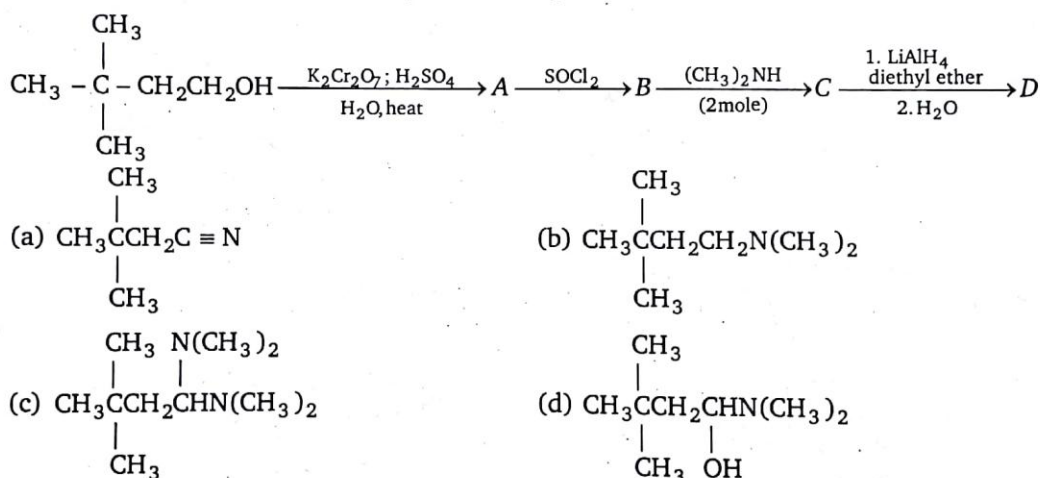
10. Identify product *D* in the following reaction sequence :

$$CH_3-C(CH_3)_2-CH_2CH_2OH \xrightarrow[H_2O,\ heat]{K_2Cr_2O_7;\ H_2SO_4} A \xrightarrow{SOCl_2} B \xrightarrow[(2mole)]{(CH_3)_2NH} C \xrightarrow[2.\ H_2O]{1.\ LiAlH_4\ diethyl\ ether} D$$

(a) $CH_3C(CH_3)_2CH_2C\equiv N$

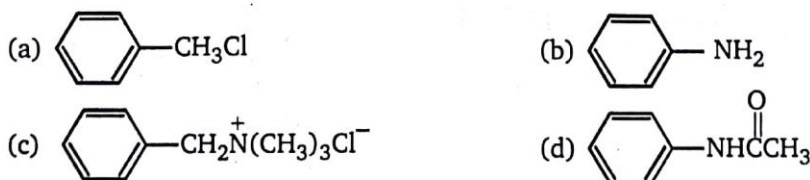
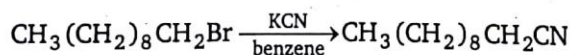
(b) $CH_3C(CH_3)_2CH_2CH_2N(CH_3)_2$

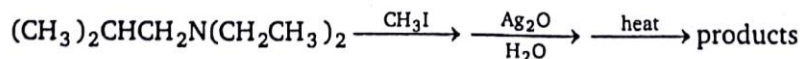
(c) $CH_3C(CH_3)_2CH_2CH(N(CH_3)_2)N(CH_3)_2$

(d) $CH_3C(CH_3)_2CH_2CH(OH)N(CH_3)_2$

11. Which one of the following is best catalyst for the reaction shown below ?

$$CH_3(CH_2)_8CH_2Br \xrightarrow[benzene]{KCN} CH_3(CH_2)_8CH_2CN$$

(a) $C_6H_5-CH_3Cl$ (b) $C_6H_5-NH_2$

(c) $C_6H_5-CH_2\overset{+}{N}(CH_3)_3Cl^-$ (d) $C_6H_5-NHCOCH_3$

12. The major products obtained from the following sequence of reactions are :

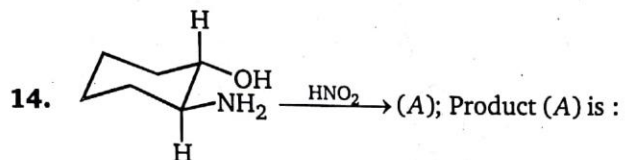
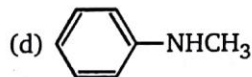
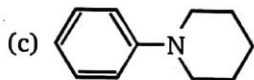
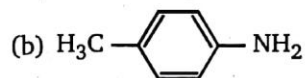
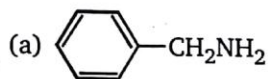
$$(CH_3)_2CHCH_2N(CH_2CH_3)_2 \xrightarrow{CH_3I} \xrightarrow[H_2O]{Ag_2O} \xrightarrow{heat} products$$

(a) $(CH_3)_2CHCH_2NH_2 + H_2C=CH_2$ (b) $(CH_3)_2NCH_2CH_3 + H_2C=C(CH_3)_2$

(c) $(CH_3)_2CHCH_2N(CH_3)CH_2CH_3 + H_2C=CH_2$ (d) $(CH_3)_3\overset{+}{N}CH_2CH_3I^- + H_2C=CH_2$

13. Which amine yields *N*-nitroso amine after treatment with nitrous acid ($NaNO_2$, HCl) ?

(a) C_6H_5–CH_2NH_2 (b) H_3C–C_6H_4–NH_2

(c) C_6H_5–N (piperidine ring) (d) C_6H_5–$NHCH_3$

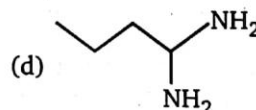
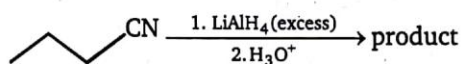
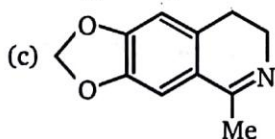
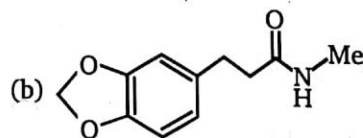
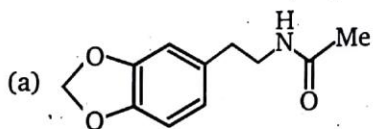
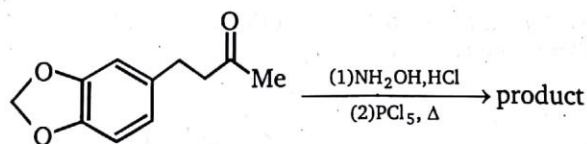
14. (cyclohexane with H, OH and H, NH_2 on adjacent carbons) $\xrightarrow{HNO_2}$ (*A*); Product (*A*) is :

(a) cyclopentane carboxyaldehyde (b) cyclohexane-1, 2-diol

(c) 2-aminocyclohexene (d) cyclohex-2-enol

15. Choose the appropriate product for this reaction.

$$\text{(butyl)–CN} \xrightarrow[2.\ H_3O^+]{1.\ LiAlH_4\text{(excess)}} \text{product}$$

(a) (butane) (b) (propyl)–CH_2NH_2

(c) (pentyl)–OH (d) (pentane with two NH_2 groups)

16. Which of the following product will be obtained in the given (consider minor product also) Beckmann-type rearrangement ?

(d) all of these

17. Deamination (or) diazotization of *n*-Bu–NH_2 with $NaNO_2$/HCl gives .... isomeric butene.

(a) 2 (b) 3 (c) 4 (d) 5

18. (4-(aminomethyl)cyclohexyl)methanol, i.e. a cyclohexane ring with CH_2OH and CH_2NH_2 groups $\xrightarrow{Ac_2O} P \xrightarrow{Ac_2O} Q$ $Ac_2O = CH_3-\overset{O}{\overset{||}{C}}-O-\overset{O}{\overset{||}{C}}-CH_3$

P and Q respectively are :

(a) $CH_2-O-\overset{O}{\overset{||}{C}}-CH_3$ / CH_2NH_2 cyclohexane , CH_2OH / $CH_2-NH-\underset{O}{\underset{||}{C}}-CH_3$ cyclohexane

(b) $CH_2-\overset{O}{\overset{||}{C}}-O-CH_3$ / CH_2NH_2 cyclohexane , $CH_2-\overset{O}{\overset{||}{C}}-O-CH_3$ / $CH_2-NH-\underset{O}{\underset{||}{C}}-CH_3$ cyclohexane

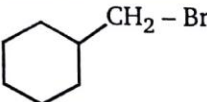
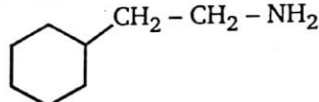
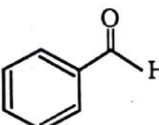
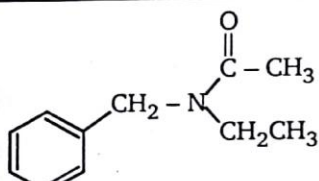
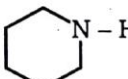
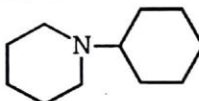
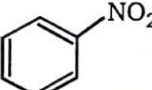
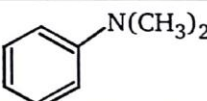
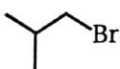
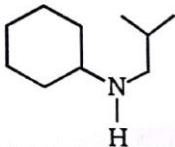
(c) CH_2OH / $CH_2-NH-\underset{O}{\underset{||}{C}}-CH_3$ cyclohexane , $CH_2-\overset{O}{\overset{||}{C}}-O-CH_3$ / $CH_2-NH-\underset{O}{\underset{||}{C}}-CH_3$ cyclohexane

(d) CH_2OH / $CH_2-NH-\underset{O}{\underset{||}{C}}-CH_3$ cyclohexane , $CH_2-O-\overset{O}{\overset{||}{C}}-CH_3$ / $CH_2-NH-\underset{O}{\underset{||}{C}}-CH_3$ cyclohexane

19. A nitrile X is treated with $LiAlH_4$ to obtain compound Y (C_2H_7N). In a separate reaction X is hydrolyzed in an acid medium to obtain Z. The product obtained after mixing Y and Z will be

(a) $CH_3CONHCH_2CH_3$ (b) $CH_3CH_2CONHCH_2CH_3$
(c) $(CH_3COO^-)(CH_3CH_2NH_3^+)$ (d) $(CH_3CH_2COO^-)(CH_3NH_2^+)$

20. The compound $X(C_7H_9N)$ reacts with benzensulfonyl chloride to give $Y(C_{13}H_{13}NO_2S)$ which is insoluble in alkali. The compound X is-

(a) benzene ring with $NHCH_3$ (b) cyclopentadiene ring with NH_2 and CH_3
(c) benzene ring with NH_2 and ortho CH_3 (d) H_3C–benzene ring–NH_2 (para)

ANSWERS — LEVEL 1															
1.	(c)	**2.**	(a)	**3.**	(d)	**4.**	(a)	**5.**	(b)	**6.**	(b)	**7.**	(d)	**8.**	(b)
9.	(d)	**10.**	(b)	**11.**	(c)	**12.**	(c)	**13.**	(d)	**14.**	(a)	**15.**	(b)	**16.**	(d)
17.	(b)	**18.**	(d)	**19**	(c)	**20.**	(a)								

1. Five amine syntheses are outlined below. In each reaction box enter a single letter designating the best reagent and conditions selected from the list at the bottom of the page.

	Starting material	Steps	Product
A.	CH_2-Br	First Step ☐ Second Step ☐	$CH_2-CH_2-NH_2$
B.	O, H	First Step ☐ Second Step ☐ Third Step ☐	O, $\overset{\Vert}{C}-CH_3$, CH_2-N, CH_2CH_3
C.	N – H	First Step ☐ Second Step ☐	N
D.	NO_2	First Step ☐ Second Step ☐	$N(CH_3)_2$
E.	Br	First Step ☐ Second Step ☐ Third Step ☐ Fourth Step ☐	N, H

(a)	(i) $LiAlH_4$ in ether (ii) H_2O & base	
(b)	$C_2H_5NH_2$(cat. $H^{(+)}$)	
(c)	NaCN in alcohol	
(d)	H_2 & Ni catalyst or H_2 & Pd catalyst	
(e)	NaN_3 in alcohol	
(f)	$(CH_3CO)_2O$ & pyridine	
(g)	C_2H_5Br	

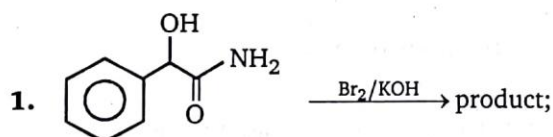
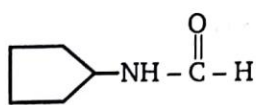
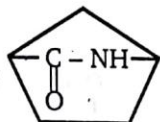
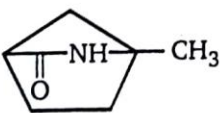
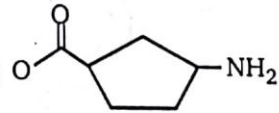
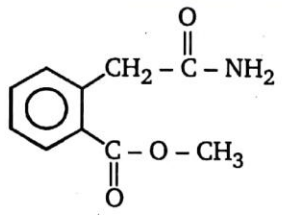
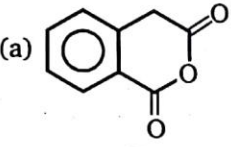
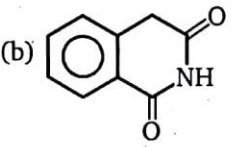
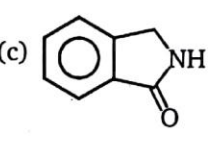
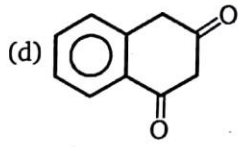
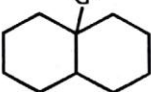
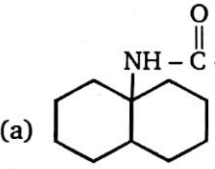
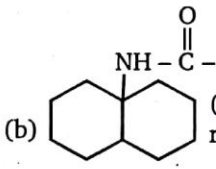
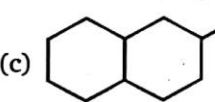
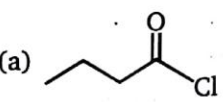
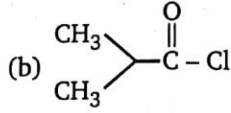
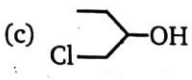
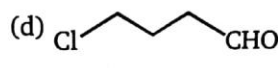
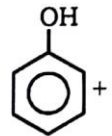
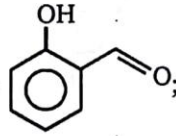
(h)	O , $H^{\oplus}$	
(i)	$2CH_3I$ & pyridine	
(j)	KOH in H_2O	

ANSWERS — LEVEL 2

1. A – c, a or c, d; B – b, d, f; C – h, d; D – d, i or a, i; E – e, a, h, a

11 CARBENE AND NITRENE

LEVEL- 1

1. $C_6H_5-CH(OH)-C(=O)-NH_2$ $\xrightarrow{Br_2/KOH}$ product;

(α-hydroxy amide)

Product of this Hoffmann bromamide reaction is :

(a) $Ph-\overset{O}{\overset{\|}{C}}-CH_3$ (b) $Ph-CHO$ (c) $Ph-CH(OH)(NO_2)$ (d) $Ph-CH_2-NH_2$

2. HO–C(=O)–(cyclopentane-1,3-diyl)–C(=O)–NH_2 $\xrightarrow{KOBr}$ (*A*) $\xrightarrow[\Delta]{}$ (*B*). Compound (*B*) is :

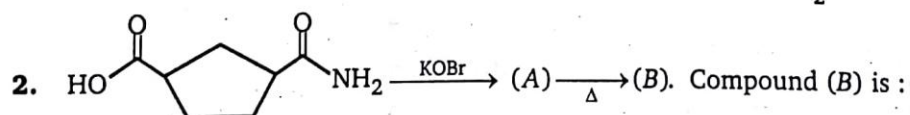
(a) Cyclopentyl–$NH-\overset{O}{\overset{\|}{C}}-H$

(b) Cyclopentane bridged by –C(=O)–NH–

(c) Cyclopentane bridged by –C(=O)–NH–, with CH_3

(d) ^{-}O–C(=O)–(cyclopentane)–NH_2

3. (o-($CH_2-\overset{O}{\overset{\|}{C}}-NH_2$)-benzene with $\underset{\overset{\|}{O}}{C}-O-CH_3$ group) $\xrightarrow{KOBr}$ (A); Product (A) is :

(a) (b) NH (c) NH (d)

4. (decalin with Me–C=N–OH) $\xrightarrow{H_2SO_4}$ Product and name of the reaction is :

(a) $NH-\overset{O}{\overset{\|}{C}}-Me$ (Hoffmann bromamide reaction)

(b) $NH-\overset{O}{\overset{\|}{C}}-Me$ (Beckmann rearrangement)

(c) CN (Curtius reaction)

(d) None of these

5. $(X)C_4H_7OCl \xrightarrow{NH_3} C_4H_9ON \xrightarrow[KOH]{Br_2} CH_3CH_2CH_2NH_2$; Compound (X) is :

(a) O, Cl (b) CH_3, CH_3 $-\overset{O}{\overset{\|}{C}}-Cl$ (c) Cl, –OH (d) Cl, CHO

6. Which of the following will not give Hoffmann bromamide reaction ?

(a) $CH_3-\overset{O}{\overset{\|}{C}}-NH_2$

(b) $Ph-\overset{O}{\overset{\|}{C}}-NH_2$

(c) $CH_3-\overset{O}{\overset{\|}{C}}-NH-Br$

(d) $Ph-\overset{O}{\overset{\|}{C}}-NH-Ph$

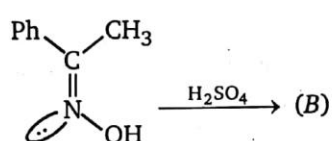
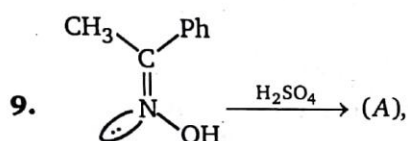
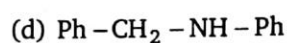
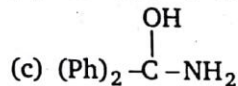
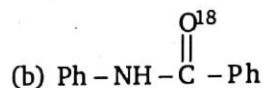
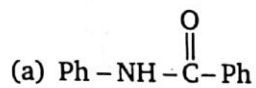
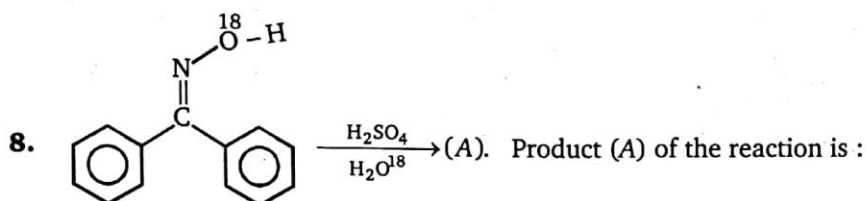
7. OH (phenol) + (x) $\xrightarrow[(2)\ H^{\oplus}]{(1)\ NaOH}$ OH (salicylaldehyde) O; Reactant x is :

(a) CH_3Cl (b) CH_2Cl_2 (c) $CHCl_3$ (d) CCl_4

8. $(C_6H_5)_2C=N-\overset{18}{O}-H \xrightarrow[H_2O^{18}]{H_2SO_4} (A)$. Product (A) of the reaction is :

(a) $Ph-NH-\overset{O}{\overset{\|}{C}}-Ph$ (b) $Ph-NH-\overset{O^{18}}{\overset{\|}{C}}-Ph$

(c) $(Ph)_2-\overset{OH}{\overset{|}{C}}-NH_2$ (d) $Ph-CH_2-NH-Ph$

9. $\xrightarrow{H_2SO_4} (A)$, $\xrightarrow{H_2SO_4} (B)$

Product (A) & (B) respectively in the above reaction are :

(a) $Ph-\overset{O}{\overset{\|}{C}}-NH-CH_3$, $Ph-\overset{O}{\overset{\|}{C}}-NH-CH_3$ (b) $CH_3-\overset{O}{\overset{\|}{C}}-NH-Ph$, $CH_3-\overset{O}{\overset{\|}{C}}-NH-Ph$

(c) $Ph-\overset{O}{\overset{\|}{C}}-NH-CH_3$, $CH_3-\overset{O}{\overset{\|}{C}}-NH-Ph$ (d) $CH_3-\overset{O}{\overset{\|}{C}}-NH-Ph$, $Ph-\overset{O}{\overset{\|}{C}}-NH-CH_3$

10. NBS $\xrightarrow{KOBr} (A)$. Product (A) is :

(a) $H_2N-CH_2-CH_2-COOH$ (b) $H_2N-CH_2-CH_2-COO^{\ominus}$ (c) succinic anhydride (cyclic, ring O) (d) succinimide (cyclic, ring NH)

11. $CH_3-\overset{Ph}{\underset{H}{C}}-\overset{O}{\overset{\|}{C}}-NH_2 \xrightarrow{NaOBr} \underset{(major)}{(A)}$; Product of the reaction is :

(a) $CH_3-\overset{Ph}{\underset{H}{C}}-NH_2$ (b) $CH_3-\overset{Ph}{\underset{NH_2}{C}}-H$

(c) $Ph-\overset{CH_3}{\underset{NH}{C}}-H$ (d) $CH_3-\overset{Ph}{\underset{H}{C}}-\overset{O}{\overset{\|}{C}}-O^{\ominus}$

12. OH / OCH_3 (p-methoxyphenol) $\xrightarrow[(2) H^{\oplus}]{(1)\ CHCl_3/NaOH}$ (A) (Major)

Product (A) is :

(a) OH, CHO, OCH_3 (b) OH, CHO, OCH_3 (c) OH, COOH, OCH_3 (d) OH, COOH, OCH_3

13. $R-\overset{O}{\overset{\|}{C}}-NH_2 + xNaOH + Br_2 \longrightarrow R-NH_2 + 2NaBr + Na_2CO_3 + H_2O$

Number of moles of NaOH used in above Hoffmann bromamide reaction is :

(a) 3 (b) 4 (c) 5 (d) 6

14. $\begin{matrix} R \\ H \end{matrix}\!\!>C=N-(\gamma)$, Rate of reaction toward Beckmann rearrangement

when $\gamma = \underset{(i)}{CH_3CO_2^-}$, $\underset{(ii)}{Cl-CH_2-CO_2^-}$, $\underset{(iii)}{Ph-SO_3^-}$

(a) (i) > (ii) > (iii) (b) (ii) > (i) > (iii)

(c) (iii) > (ii) > (i) (d) (iii) > (i) > (ii)

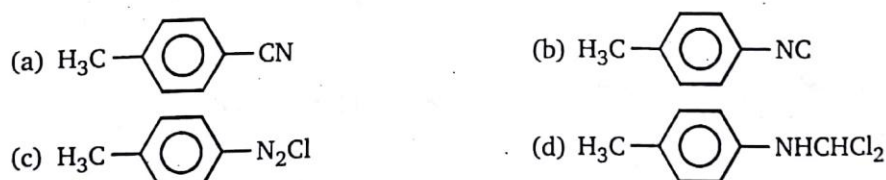
15. When primary amine reacts with chloroform in ethanolic KOH, then product is :

(a) an isocyanide (b) an aldehyde

(c) a cyanide (d) an alcohol

16. The reaction of chloroform with alcoholic KOH and *p*-toluidine forms :

(a) $H_3C-C_6H_4-CN$ (b) $H_3C-C_6H_4-NC$

(c) $H_3C-C_6H_4-N_2Cl$ (d) $H_3C-C_6H_4-NHCHCl_2$

17. What is the product (Q) of the following reaction ?

(a)

(b)

(c) (d)

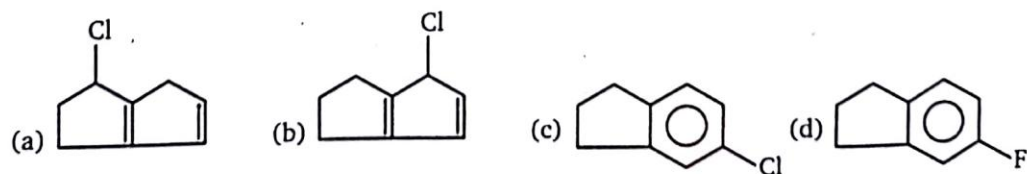
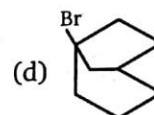
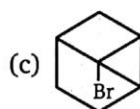
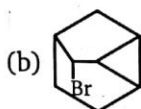
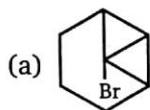
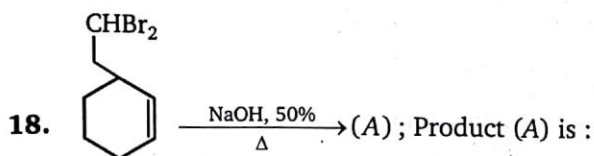
18.

$\xrightarrow[\Delta]{\text{NaOH, 50\%}}(A)$; Product (A) is :

(a)

(b)

(c)

(d)

19. Which of the following reaction, does not give chloro benzene as a product ?

(a) $\xrightarrow{CHCl_3,\ HO^-}$

(b)

(c) $\xrightarrow{CHBr_2Cl,\ HO^-}$

(d)

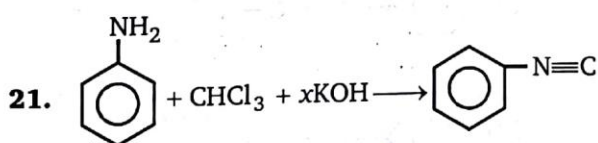
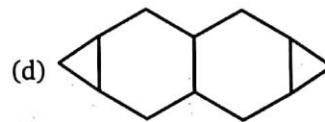
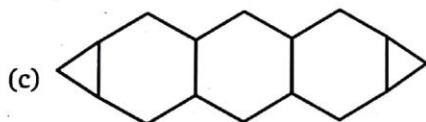
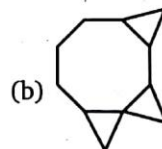
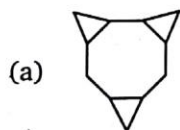
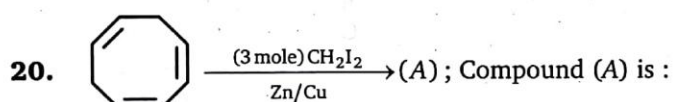
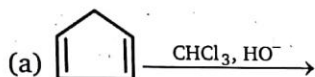
20. $\xrightarrow[\text{Zn/Cu}]{(3\,\text{mole})\,CH_2I_2}(A)$; Compound (A) is :

(a)

(b)

(c)

(d)

21.

x = moles of KOH consumed is :

(a) 1 (b) 2 (c) 3 (d) 4

22. Heating the acyl azide in dry toluene under reflux for 3-hours give a 90% yield for a heterocyclic product. Identify the product (A).

(2-aminobenzoyl azide, o-$H_2N-C_6H_4-C(=O)-N_3$) $\xrightarrow[\text{toluene}]{\text{heat}}$ (A) 90%

(a) (benzimidazol-2-one structure: N–H, C=O, N–H)

(b) (structure: C=O, N–H, N–H)

(c) (structure: C=O, NH_2)

(d) (structure: NH–NH_2, C=O)

23. (structure: $\overset{*}{C}$=C(H)Br, with phenyl and p-bromophenyl on $\overset{*}{C}$) $\xrightarrow[\text{Heat}]{\overset{\oplus}{K}\overset{-}{O}C(CH_3)_3}$ (A)

Br $(\overset{*}{C} = \overset{14}{C})$

(a) $C_6H_5-\overset{*}{C}\equiv C-C_6H_4-Br$

(b) $C_6H_5-C\equiv \overset{*}{C}-C_6H_4-Br$

(c) $C_6H_5-C\equiv C-C_6H_5$

(d) $C_6H_5-C\equiv C-C_6H_4$ (Br at meta position)

24. [Structure: cyclohexene with CO_2H, three OH groups] $\xrightarrow[\text{(2) acetone/H}^+ \text{ (3)Ac}_2\text{O, Acetic anhydride}]{\text{(1) CH}_2\text{N}_2}$ (A) (de-colourises Br_2 water)

Product (A) of the above reaction is :

(a) [Structure: CO_2CH_3, OAc, O–C acetonide]

(b) [Structure: CO_2CH_3, OAc, acetonide with CH_3 CH_3]

(c) [Structure: CO_2Ac, OMe, acetonide]

(d) [Structure: CO_2H, AcO, OMe, OMe]

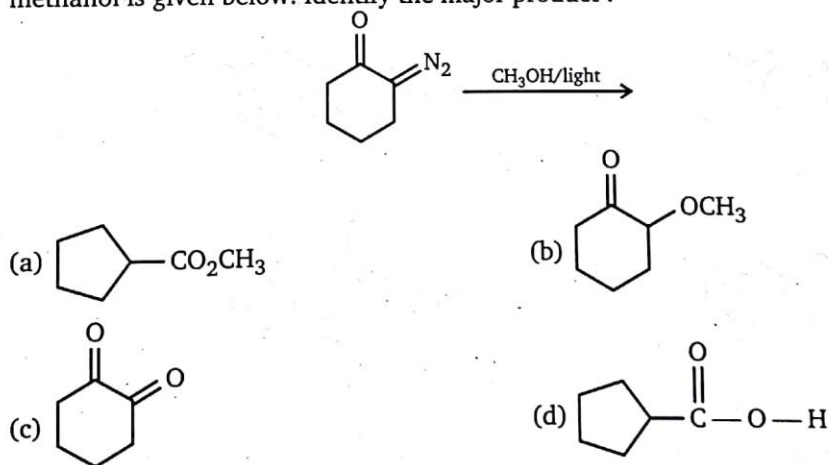
25. A rather interesting example of the Wolff rearrangement with 2-diazocyclohexanone in methanol is given below. Identify the major product :

[Structure: 2-diazocyclohexanone, O, N_2] $\xrightarrow{CH_3OH/light}$

(a) [Structure: cyclopentane–CO_2CH_3]

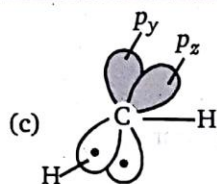
(b) [Structure: cyclohexanone with OCH_3]

(c) [Structure: cyclohexane-1,2-dione, O, O]

(d) [Structure: cyclopentane–C(=O)–O–H]

26. The orbital picture of a singlet carbene ($:CH_2$) can be drawn as :

(a) [Orbital diagram: H, H, C, p, sp^2]

(b) [Orbital diagram: H, H, C, p, sp^2]

(c)

(d) none of these

27. The orbital picture of a triplet carbene can be drawn as :

(a)

(b)

(c)

(d) none of these

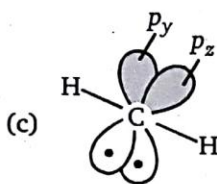
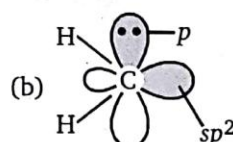
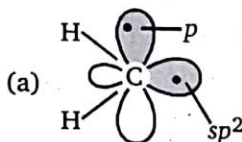
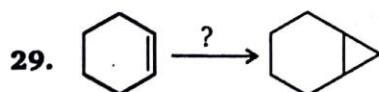
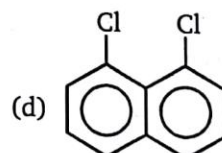
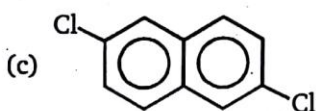
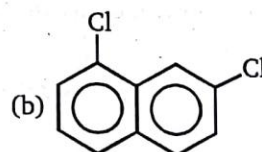
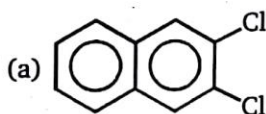
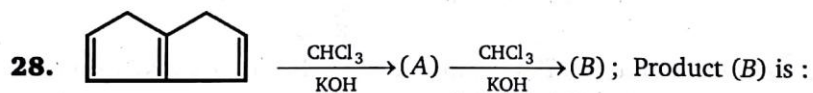
28. $\xrightarrow[\text{KOH}]{\text{CHCl}_3} (A) \xrightarrow[\text{KOH}]{\text{CHCl}_3} (B)$; Product (B) is :

(a)

(b)

(c)

(d)

29. $\xrightarrow{?}$

Select the suitable reagent for above conversion.

(a) CH_2N_2 / Δ

(b) CBr_4 / RLi

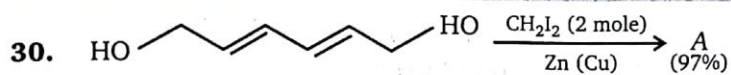
(c) $H_2C = CH_2$

(d) t-BuOK

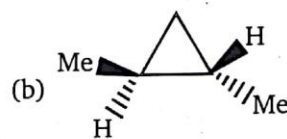
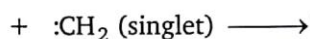
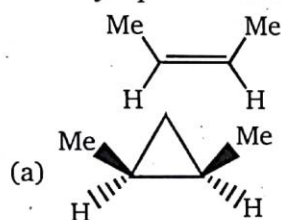
30. HO–CH₂–CH=CH–CH=CH–CH₂–OH $\xrightarrow[\text{Zn (Cu)}]{CH_2I_2 \text{ (2 mole)}}$ A (97%)

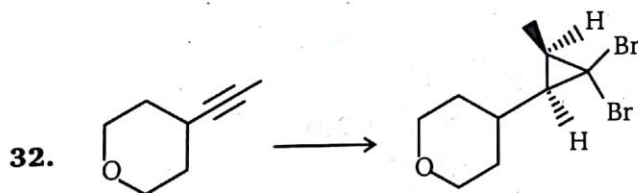
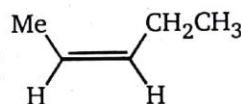
Product (A) will be :

(a) (b) HO HO

(c) HO HO (d) CH_3O OCH_3

31. The major product formed in the following reaction is

Me Me H H + :CH_2 (singlet) ⟶

(a) Me Me H H (b) Me H H Me

(c) 50 : 50 mixture of above two compounds (d) Me CH_2CH_3 H H

32. ⟶ H Br Br H

To carry out above conversion reagent used in decreasing order.

(a) Na/liq. NH_3, $CHBr_3/NaOH(\Delta)$ (b) $H_2/Pd-CaCO_3$, $CHBr_3/NaOH(\Delta)$

(c) Na/liq. NH_3, $CHCl_3/NaOH$ (d) $H_2/Pd-CaCO_3$, $CHCl_3/NaOH$

33. O O CH_2 $\xrightarrow[KOH]{Br_2}$ (A) + $CHBr_3$ ↓

Product (A) of the reaction is :

(a) CO_2H CO_2H (b) CO_2H C – CH_3 O (c) CO_2^- CO_2^- (d) CH_3 CO_2H

34. $O_2N-C_6H_4-C\equiv N$ (para) $\xrightarrow[\text{(2) HO}^-, Br_2]{\text{(1) HO}^-\text{(1 mole)}}$ (A); Product (A) is :

(a) CO_2^- / NH_2 (para-substituted benzene)   (b) NO_2 / NO_2 (para-substituted benzene)   (c) NH_2 / NO_2 (para-substituted benzene)   (d) NO_2 / Br (para-substituted benzene)

35. (3-Nitrophthalimide: benzene ring fused with C(=O)–NH–C(=O), NO_2 adjacent to ring fusion) $\xrightarrow[H_2O]{NaOCl}$ (X) ; Product X will be :
(80%)

(a) Benzene with CO_2H, NH_2, NO_2 (adjacent, NH_2 between CO_2H and NO_2)   (b) Benzene with NH_2, CO_2H, NO_2 (CO_2H between NH_2 and NO_2)

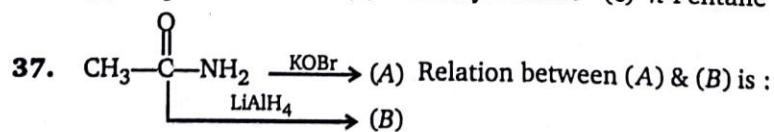
(c) Benzene with CO_2H, CO_2H, NO_2 (adjacent)   (d) Benzene with NH_2, CO_2H (ortho) and NO_2 para to NH_2

36. $CH_3-CH_2-CH_2-CH_2-CH_3 \xrightarrow{CH_2N_2/\Delta}$ Products

Which of the following product(s) is/are can be obtained in the above reaction.

(a) Isopentane   (b) 3-Methyl hexane   (c) n-Pentane   (d) 3-Methyl pentane

37. $CH_3-\overset{O}{\overset{\|}{C}}-NH_2 \xrightarrow{KOBr} (A)$ Relation between (A) & (B) is :

$\xrightarrow{LiAlH_4} (B)$

(a) Identical   (b) Functional isomer   (c) Homologous   (d) Positional isomers

38. If we use pyrene (CCl_4) in the Riemer-Tiemann reaction in place of chloroform, the product formed is :

(a) Salicylaldehyde (b) Phenolphthalein (c) Salicylic acid (d) Cyclohexanol

39. When ethyl amine is heated with chloroform and alcoholic KOH, a compound with offensive smell is obtained. This compound is :

(a) A secondary amine (b) An isocyanide

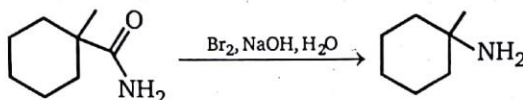
(c) A cyanide (d) An acid

40. Which of the following species would not be involved in the Hoffmann rearrangement shown below ?

O, NH_2 —Br_2, NaOH, H_2O→ NH_2

(a) O, NHBr

(b) O, $\overset{\ominus}{N}$—Br

(c) N=C=O

(d) All of the above are involved in the reaction.

41. In which of the following reactions migration of alkyl group from carbon to oxygen is observed ?

(a) Pinacol-pinacolone rearrangement

(b) Bayer-villiger oxidation.

(c) Prepration of phenol from cumene hydroperoxide.

(d) Both (b) & (c)

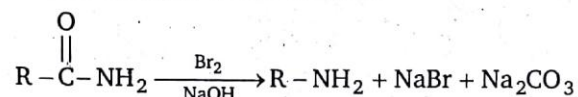
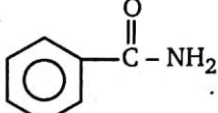
ANSWERS — LEVEL 1

1.	(b)	**2.**	(b)	**3.**	(c)	**4.**	(b)	**5.**	(a)	**6.**	(d)	**7.**	(c)	**8.**	(b)
9.	(c)	**10.**	(b)	**11.**	(a)	**12.**	(a)	**13.**	(b)	**14.**	(c)	**15.**	(a)	**16.**	(b)
17.	(d)	**18.**	(a)	**19.**	(d)	**20.**	(a)	**21.**	(c)	**22.**	(a)	**23.**	(b)	**24.**	(b)
25.	(a)	**26.**	(a)	**27.**	(c)	**28.**	(c)	**29.**	(a)	**30.**	(b)	**31.**	(a)	**32.**	(b)
33.	(c)	**34.**	(c)	**35.**	(b)	**36.**	(d)	**37.**	(c)	**38.**	(c)	**39.**	(b)	**40.**	(d)
41.	(d)														

LEVEL-2

1. Comprehension

Hoffmann bromamide reaction involves conversion of a carboxylic acid amide into an amine with a loss of a carbon atom on treatment with aqueous sodium hypobromite. Thus Hoffmann result in shortening of a carbon chain.

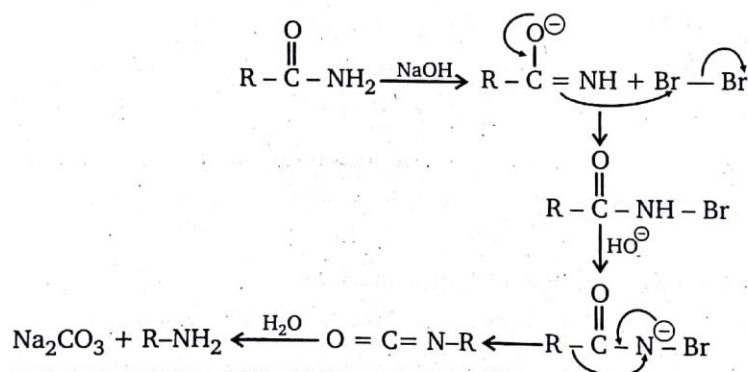
$$R-\overset{O}{\overset{\|}{C}}-NH_2 \xrightarrow[NaOH]{Br_2} R-NH_2 + NaBr + Na_2CO_3$$

Mechanism of the reaction is :

$$R-\overset{O}{\overset{\|}{C}}-NH_2 \xrightarrow{NaOH} R-\overset{O^{\ominus}}{\overset{|}{C}}=NH + Br-Br$$

$$\downarrow$$

$$R-\overset{O}{\overset{\|}{C}}-NH-Br$$

$$\downarrow HO^{\ominus}$$

$$Na_2CO_3 + R\text{–}NH_2 \xleftarrow{H_2O} O=C=N\text{–}R \longleftarrow R-\overset{O}{\overset{\|}{C}}-\overset{\ominus}{N}-Br$$

A. Number of moles of NaOH consumed in above reaction.

(a) 1 (b) 2 (c) 3 (d) 4

B. $C_6H_5-\overset{O}{\overset{\|}{C}}-NH_2 \xrightarrow[KOH]{Br_2} \underset{(Major)}{(A)}$; Product (A) :

(a) $Ph-NH_2$ (b) $Ph-CH_2-NH_2$ (c) $Ph-NH-CH_3$ (d) $Ph-N(CH_3)_2$

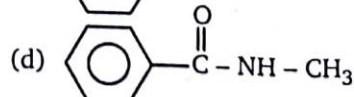
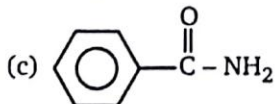
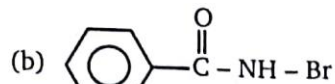
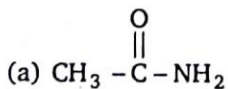
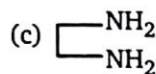
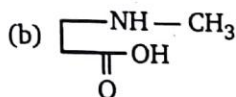
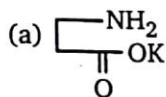
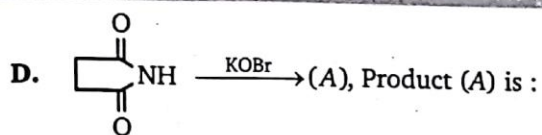
C. Which of the following will not give Hoffmann bromamide reaction.

(a) $CH_3-\overset{O}{\overset{\|}{C}}-NH_2$

(b) $C_6H_5-\overset{O}{\overset{\|}{C}}-NH-Br$

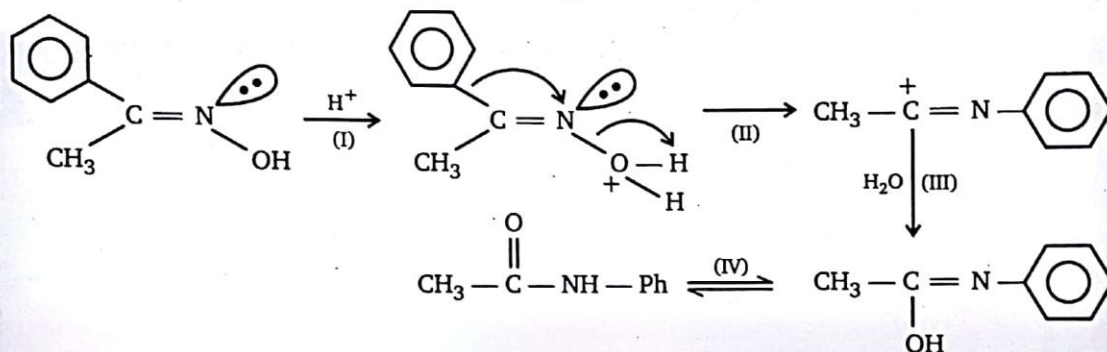
(c) $C_6H_5-\overset{O}{\overset{\|}{C}}-NH_2$

(d) $C_6H_5-\overset{O}{\overset{\|}{C}}-NH-CH_3$

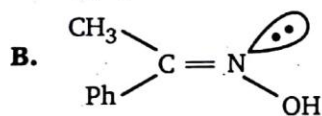
D. (Succinimide) $\xrightarrow{KOBr}$ (A), Product (A) is :

(a) NH_2–CH_2CH_2–C(=O)OK (b) CH_2(NH–CH_3)CH_2C(=O)OH (c) $NH_2CH_2CH_2NH_2$ (d) None of these

2. Comprehension

Given is mechanism of Beckmann rearrangement.

$$\text{PhC(CH}_3\text{)=N–OH} \xrightarrow[\text{(I)}]{H^+} \text{PhC(CH}_3\text{)=N–}\overset{+}{O}H_2 \xrightarrow{\text{(II)}} CH_3-\overset{+}{C}=N-Ph \xrightarrow[\text{(III)}]{H_2O} CH_3-C(OH)=N-Ph \underset{}{\overset{\text{(IV)}}{\rightleftharpoons}} CH_3-\overset{O}{\overset{\|}{C}}-NH-Ph$$

A. Rate determining step in Beckmann rearrangement :

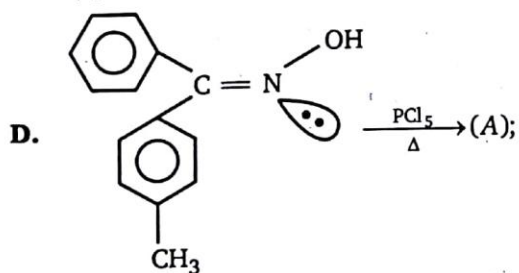
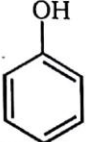
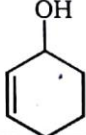
(a) I (b) II (c) III (d) IV

B. CH_3(Ph)C=N–OH

On treatment H_2SO_4 followed by hydrolysis in acidic medium above compound gives.

(a) CH_3-CO_2H, $Ph-NH_2$ (b) $CH_3-NH_2, Ph-CO_2H$

(c) $Ph-CH_2-NH_2+Ph-CO_2H$ (d) $Ph-CO_2H+CH_3-CO_2H$

C. Which of the following reagent cannot used in Beckmann rearrangement ?

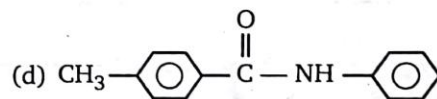
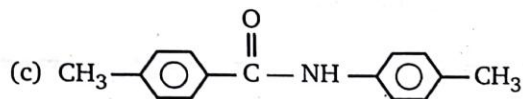
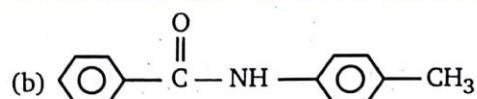
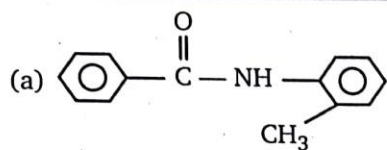
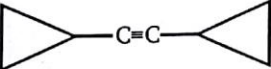
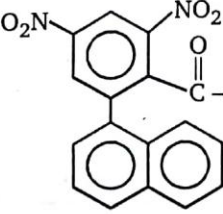
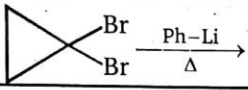
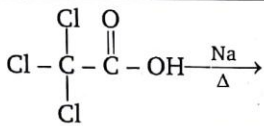
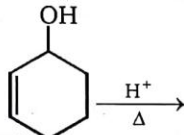
(a) TsOH (b) $R-SO_2Cl$ (c) BF_3 (d) $Ph-Li$

D.

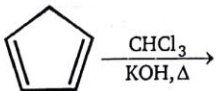
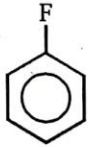
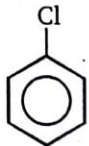
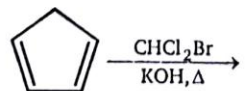
$\xrightarrow[\Delta]{PCl_5}$ (A);

Product (A) of the above reaction is :

(a) $C_6H_5-\overset{O}{\overset{\|}{C}}-NH-C_6H_4-CH_3$ (ortho) (b) $C_6H_5-\overset{O}{\overset{\|}{C}}-NH-C_6H_4-CH_3$ (para)

(c) $CH_3-C_6H_4-\overset{O}{\overset{\|}{C}}-NH-C_6H_4-CH_3$ (d) $CH_3-C_6H_4-\overset{O}{\overset{\|}{C}}-NH-C_6H_5$

3. Match the column I and II.

	Column (I)		Column (II)
(a)	3-chlorocyclopentene (Cl) $\xrightarrow{\text{aq. KOH}} (A) \xrightarrow[\Delta]{H^+} (B) \xrightarrow[\text{KOH}]{CHCl_3} (C)$	**(p)**	D.B.E. = even for product (Double bond equivalent)
(b)	1-indanol (OH) $\xrightarrow[\Delta]{H^+} (A) \xrightarrow[\text{KOH}]{CHCl_3} (B)$	**(q)**	D.B.E. = odd for product
(c)	bicyclic diene $\xrightarrow[\text{KOH}]{CHCl_3} (A) \xrightarrow[\text{KOH}]{CHCl_3} (B)$	**(r)**	Ring expansion takes place
(d)	2-hydroxy-2,3-dihydropyrrole (N–H, OH) $\xrightarrow[\Delta]{H^+} (A) \xrightarrow[\Delta]{CHFClBr} (B)$	**(s)**	Carbene will formed

4. Match the column I and II.

	Column (I)		Column (II)
(a)	Cyclopentadiene $\xrightarrow[KOH]{CHCl_3}$	**(p)**	Reimer Tiemann reaction
(b)	Phenol (OH) $\xrightarrow[KOH]{CHCl_3}$	**(q)**	Reimer Tiemann expansion (**or**) Abnormal RNT reaction
(c)	Cyclohexene $\xrightarrow[\Delta]{CCl_3COONa}$	**(r)**	Simman-smith reaction.
(d)	Cyclohex-2-en-1-ol (OH) $\xrightarrow[\Delta]{CH_2I_2+Zn}$	**(s)**	Increase in carbon takes place

5. Match the column I and II.

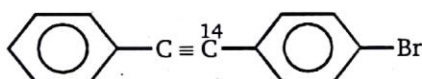
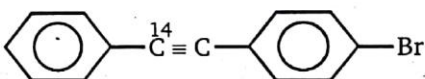
	Column (I)		Column (II)
(a)	Cyclopropene–CO_2H $\xrightarrow{SOCl_2}$ $\xrightarrow{NH_3}$ $\xrightarrow{KOBr}$ $\xrightarrow{HNO_2}$	**(p)**	Aromatic compound will formed
(b)	Cyclopropene–C≡C–cyclopropene $\xrightarrow[h\nu]{\text{cyclopropenyl–C(Cl)(N=N) diazirine}}$ (A)	**(q)**	Migration take place from carbon to electron deficient nitrogen
(c)	$\phi-CHCl_2 \xrightarrow{t-BuO^{\ominus}K^{\oplus}} (A) \xrightarrow{\phi-C\equiv C-\phi} (B) \xrightarrow{AlCl_3} (C)$	**(r)**	Carbene will formed in this reaction
(d)	O_2N, NO_2-substituted benzene bearing $\overset{O}{\overset{\parallel}{C}}-NH_2$ and 1-naphthyl group $\xrightarrow{KOBr}$	**(s)**	N_2 will evolve.

6. Match the column I and II:

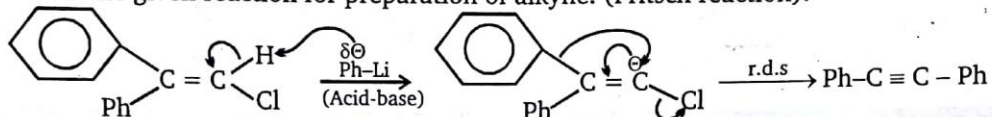
	Column (I)		Column (II)
	Reaction		**Intermediate**
(a)	$CHCl_3 + KOH \xrightarrow{\Delta}$	**(p)**	Carbocation
(b)	1,1-dibromocyclopropane (Br, Br) $\xrightarrow[\Delta]{Ph-Li}$	**(q)**	Carbanion
(c)	$Cl-C(Cl)_2-C(=O)-OH \xrightarrow[\Delta]{Na}$	**(r)**	Free radical
(d)	cyclohex-2-en-1-ol (OH) $\xrightarrow[\Delta]{H^+}$	**(s)**	Carbene

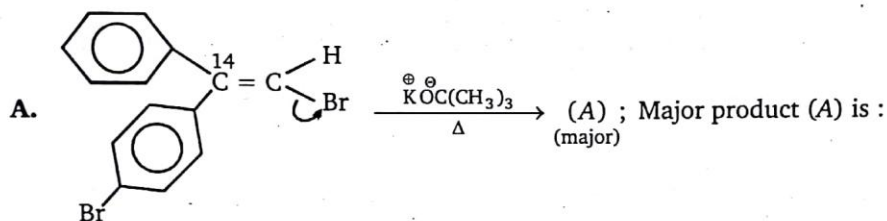
7. Matrix :

	Column (I)		Column (II)
	Reaction		**Product**
(a)	cyclopentadiene $\xrightarrow[KOH,\Delta]{CHCl_3}$	**(p)**	fluorobenzene (F)
(b)	cyclopentadiene $\xrightarrow[KOH,\Delta]{CHFClBr}$	**(q)**	chlorobenzene (Cl)
(c)	cyclopentadiene $\xrightarrow[KOH,\Delta]{CHCl_2Br}$	**(r)**	bromobenzene (Br)

(d)	$\xrightarrow[KOH, \Delta]{CHBr_2Cl}$	(s)	

8. Comprehension

1. Consider the given reaction for preparation of alkyne. (Fritsch reaction).

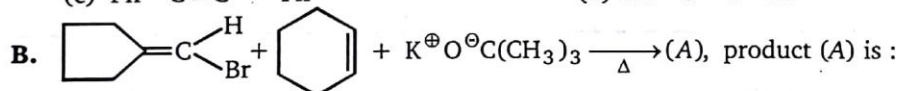
$\xrightarrow[\text{(Acid-base)}]{\delta\ominus\ Ph\text{–}Li}$ $\xrightarrow{r.d.s}$ Ph–C ≡ C – Ph

Anti group will migrate because of less steric hindrance.

A. $\xrightarrow[\Delta]{\overset{\oplus}{K}\overset{\ominus}{O}C(CH_3)_3}$ (A) ; Major product (A) is :
(major)

(a)

(b)

(c) Ph – C ≡ C^{14} – Ph

(d) Ph – C ≡ C – Ph

B. + $K^{\oplus}O^{\ominus}C(CH_3)_3 \xrightarrow{\Delta}$ (A), product (A) is :

(a)

(b)

(c)

(d)

C. Rate of reaction when the halide ion:

(a) $I^{\ominus} > Cl^{\ominus} > Br^{\ominus} > F^{\ominus}$

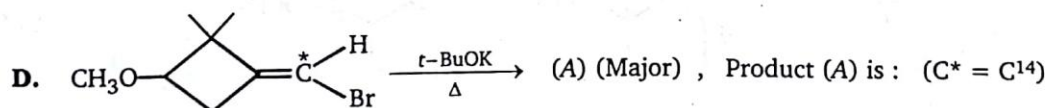
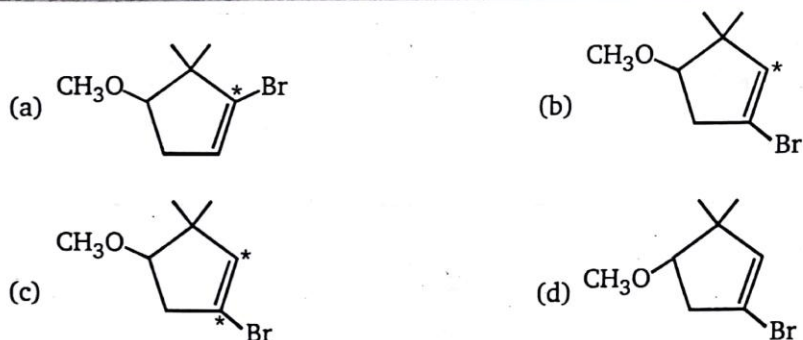
(b) $I^{\ominus} > Br^{\ominus} > Cl^{\ominus} > F^{\ominus}$

(c) $F^{\ominus} > Cl^{\ominus} > Br^{\ominus} > I^{\ominus}$

(d) $F^{\ominus} > Br^{\ominus} > Cl^{\ominus} > I^{\ominus}$

D. CH_3O– $\xrightarrow[\Delta]{t\text{-BuOK}}$ (A) (Major) , Product (A) is : ($C^* = C^{14}$)

(a) (b)

(c) (d)

9. Comprehension

Wolff rearrangement

When α-Diazoketones are photo-irradiated or heated at high temperature or reacted with silver oxide or silver salts at room temperature, they loose nitrogen and rearrange to form ketene.

The ketenes reacts rapidly with water, alcohol and amines. Therefore, the reactions called Wolff-rearrangement.

$$C_6H_5-\overset{O}{\overset{||}{C}}-CHN_2 \xrightarrow{Ag_2O} N_2 + Ph-CH=C=O$$

$$Ph-CH=C=O \xrightarrow{H_2O} Ph-CH_2-CO_2H$$

$$Ph-CH=C=O \xrightarrow{CH_3-NH_2} Ph-CH_2-\overset{O}{\overset{||}{C}}-NH-CH_3$$

A. $Ph-\overset{O}{\overset{||}{\underset{14}{C}}}-CHN_2 \xrightarrow[H_2O]{Ag_2O} (A)$, Product (A) is :

(a) $Ph-\overset{14}{C}H_2-CO_2H$ (b) $Ph-CH_2-\overset{14}{C}O_2H$

(c) $Ph-\overset{14}{C}O_2H$ (d) $Ph-CO_2H$

B. $\xrightarrow[h\nu]{CH_3OH}$ (A) (Major), Product (A) is :

$(\overset{*}{C} = \overset{14}{C})$

(a) OCH_3 (b) $\overset{O}{\overset{||}{C}}-OCH_3$ (c) $\overset{O}{\overset{||}{C}}-OCH_3$ (d) $\overset{O}{\overset{||}{C}}-OCH_3$

C. CH_3(H)(Et)C–C(=O)–CHN_2 + $CH_3OH \xrightarrow{Ag_2O}$ Major product of the reaction is :

(a) CH_3(Et)(H)C–C(=O)–OCH_3 (b) CH_3(H)(Et)C–C(=O)–OCH_3

(c) H(CH_3)(Et)C–C(=O)–OCH_3 (d) None of these

D. Decalin bearing two –C(=O)–CHN_2 groups $\xrightarrow[NH_3]{Ag_2O}$ (*A*) (Major) , Product (*A*) is :

(a) Decalin bearing two –C(=O)–NH_2 groups (hashed bonds)

(b) Decalin bearing two –CH_2–C(=O)–NH_2 groups (hashed bonds)

(c) Decalin bearing two –C(=O)–NH_2 groups (wedged bonds)

(d) Decalin bearing –CH_2 – $CONH_2$ (hashed) and –CH_2 – $CONH_2$ (wedged)

E. Ph – C(=N_2) –CH_2OCH_3 $\xrightarrow{\Delta}$ (*A*) 90% , product (*A*) is :

(a) Ph – CH = CH – OH (b) Ph – CH = CH – OCH_3

(c) CH_3 – CH = CH – O – PH (d) CH_3 – CH = CH – OH

F. $\xrightarrow[CH_3OH]{h\nu}$ (*A*) , Product (*A*) is :

(a)

(b)

(c)

(d) CO_2CH_3, O

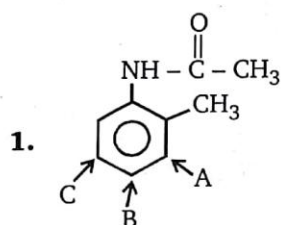
G. $HO-CH_2-CH_2-CH_2-\overset{O}{\overset{||}{C}}-CHN_2 \xrightarrow[\Delta]{Ag_2O} (A)$, Product (A) is :

(a) (b) (c) (d)

ANSWERS — LEVEL 2

1. A – d, ; B – a; C – d, ; D – a,
2. A – b; B – b; C – d; D – b
3. a – p, r, s; b – q, r, s; c – q, r, s; d – p, r, s
4. a – q, s; b – p, s; c – s; d – r, s
5. a – p, q, s; b → p, r, s; c – p, r ; d – p, q
6. a – q, s; b – q, s; c – q, s; d – p
7. a – q; b – p; c – q; d – q
8. A – a; B – c; C – b; D – b
9. A – b; B – c; C – d; D – b; E – b; F – b; G – c

12 AROMATIC COMPOUNDS

1. $NH-\overset{O}{\overset{||}{C}}-CH_3$, CH_3 (ring positions marked A, B, C)

Identify the position where electrophilic aromatic substitution (EAS) is most favourable.

(a) A (b) B

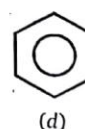
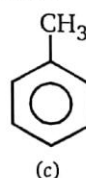
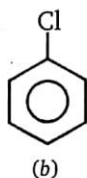
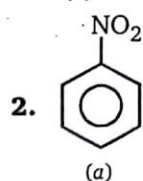
(c) C (d) A and C

2.

(a)

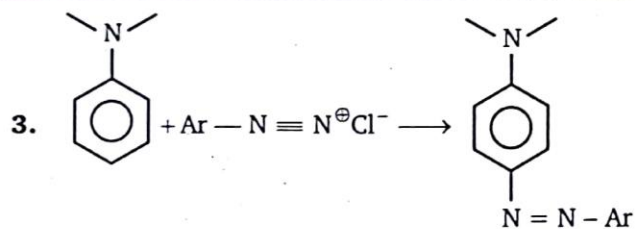
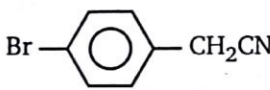
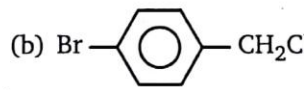
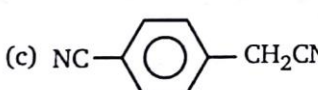
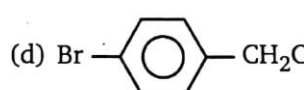
(b)

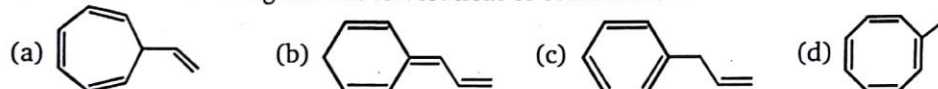
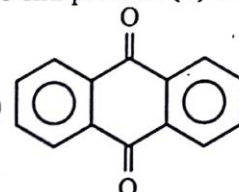
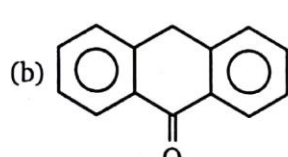
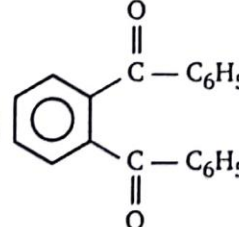
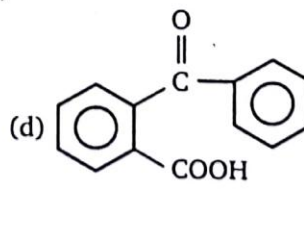
(c)

(d)

Correct order of rate of EAS (electrophilic aromatic substitution) is :

(a) $c > b > a > d$ (b) $c > d > a > b$

(c) $a > b > c > d$ (d) $c > d > b > a$

3. (Me)$_2$N–C$_6$H$_5$ + $Ar-N\equiv N^{\oplus}Cl^-$ ⟶ p-(Me)$_2$N–C$_6$H$_4$–N = N – Ar

Above (C—N) coupling reaction take place at :

(a) low pH (b) Intermediate pH
(c) high pH (d) any pH

4. Which of the following has the lowest heat of combustion ?

(a) (b) (c) (d)

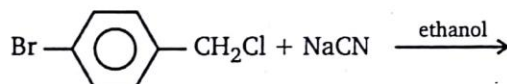
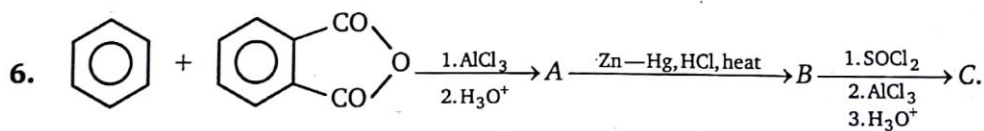
5. The product obtained from the reaction is :

$$Br-C_6H_4-CH_2Cl + NaCN \xrightarrow{\text{ethanol}}$$

(a) Br–C$_6$H$_4$–CH_2CN (b) Br–C$_6$H$_4$–CH_2Cl
(c) NC–C$_6$H$_4$–CH_2CN (d) Br–C$_6$H$_3$(CN)–CH_2Cl

6. Benzene + Phthalic anhydride $\xrightarrow[2.\ H_3O^+]{1.\ AlCl_3}$ A $\xrightarrow{Zn—Hg,\ HCl,\ heat}$ B $\xrightarrow[2.\ AlCl_3\ 3.\ H_3O^+]{1.\ SOCl_2}$ C.

The end product (C) is :

(a) Anthraquinone (b) Anthrone
(c) C$_6$H$_4$(CO–C$_6$H$_5$)$_2$ (d) C$_6$H$_5$–CO–C$_6$H$_4$–COOH

7. How many benzylic hydrogens are present in the hydrocarbon shown below ?

(a) 3 (b) 4 (c) 5 (d) 6 (e) 8

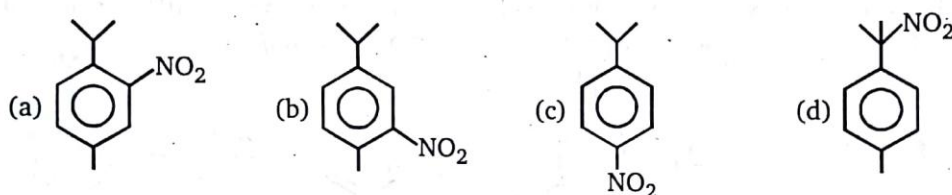
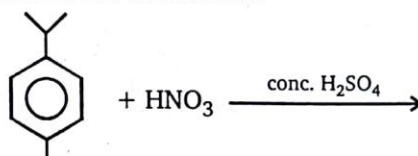
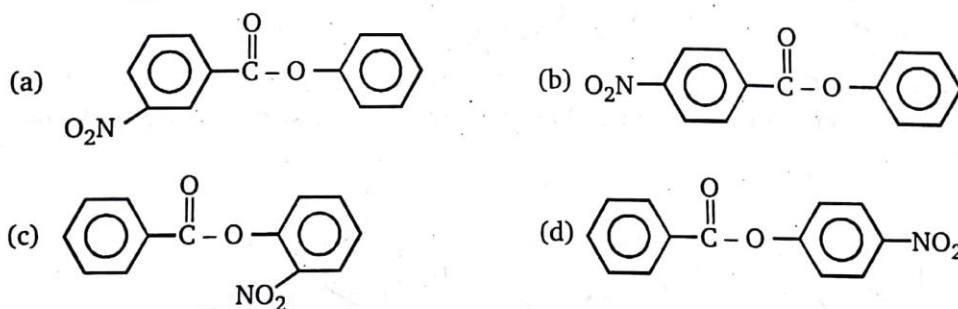
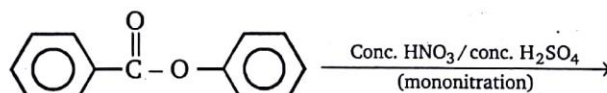
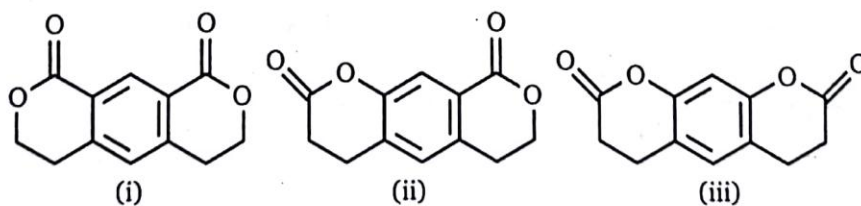
8. The major product formed in the reaction is :

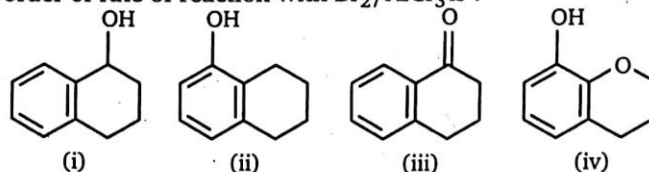
$+ HNO_3 \xrightarrow{\text{conc. } H_2SO_4}$

(a) NO_2 (b) NO_2 (c) NO_2 (d) NO_2

9. The major product formed in the reaction is :

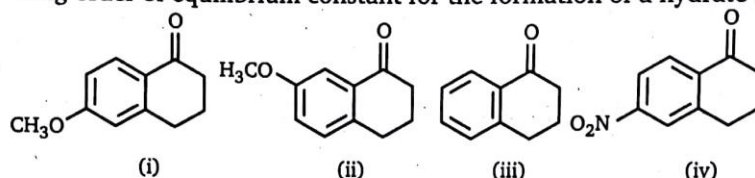
$\xrightarrow[\text{(mononitration)}]{\text{Conc. } HNO_3/\text{conc. } H_2SO_4}$

(a) O_2N (b) O_2N (c) NO_2 (d) NO_2

10. Increasing order of rate of reaction with HNO_3/H_2SO_4 is :

(a) iii < ii< i (b) ii < iii < i (c) i < iii < ii (d) i < ii < iii

11. Increasing order of rate of reaction with $Br_2/AlCl_3$ is :

(i) (ii) (iii) (iv)

(a) iii < i < ii < iv (b) iv < ii < i < iii (c) ii < iv < iii < i (d) iv < ii < iii < i

12. Increasing order of equilibrium constant for the formation of a hydrate is :

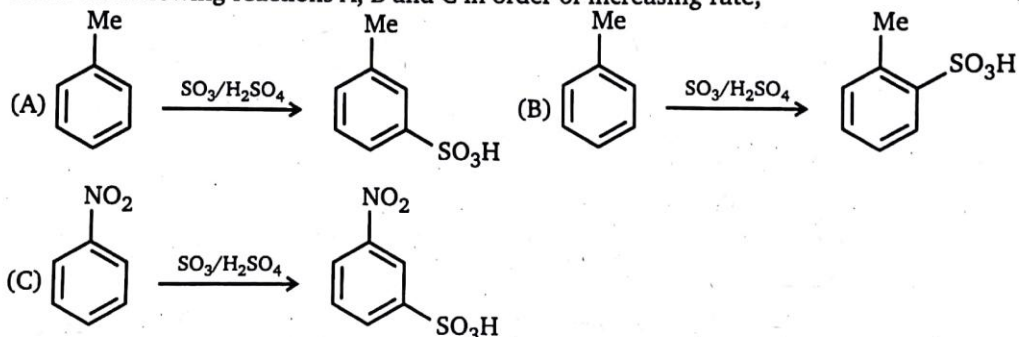
CH_3O H_3CO O_2N

(i) (ii) (iii) (iv)

(a) i < ii < iii < iv (b) iv < ii < i < iii (c) ii < iv < iii < i (d) iv < ii < iii < i

13. Rank the following reactions A, B and C in order of increasing rate,

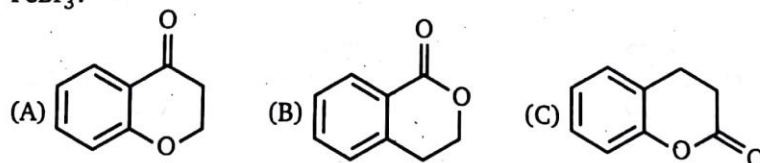
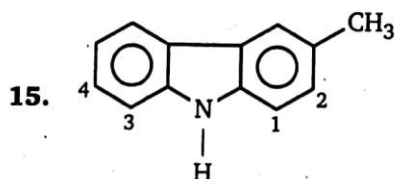
(A) Me-benzene $\xrightarrow{SO_3/H_2SO_4}$ Me, SO_3H (meta)

(B) Me-benzene $\xrightarrow{SO_3/H_2SO_4}$ Me, SO_3H (ortho)

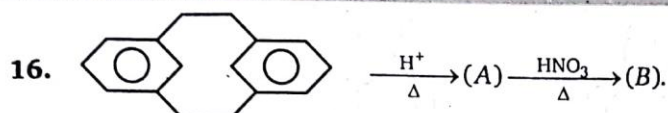
(C) NO_2-benzene $\xrightarrow{SO_3/H_2SO_4}$ NO_2, SO_3H (meta)

(a) B > A > C (b) B > C > A (c) A > B > C (d) A > C > B

14. Rank in order of increasing rate of reaction towards EAS with bromine in the presence of $FeBr_3$.

(a) B < A < C (b) B < C < A
(c) A < B < C (d) A < C < B

15.

Identify the position where E.A.S. can take place.

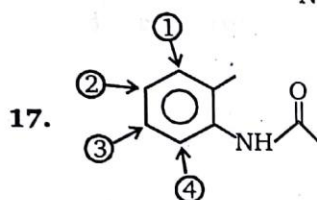
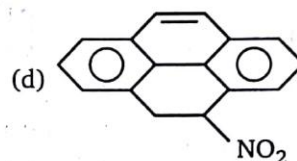
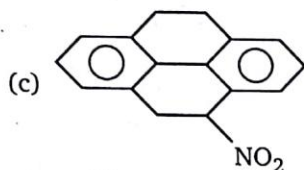
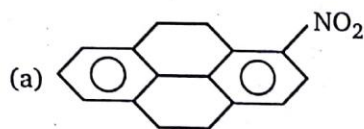
(a) 1 (b) 2 (c) 3 (d) 4

16. $\xrightarrow[\Delta]{H^+} (A) \xrightarrow[\Delta]{HNO_3} (B).$

Product (B) in the above reactions is:

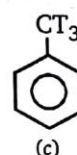
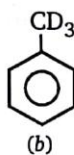
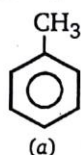
(a)

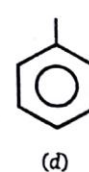
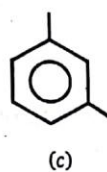
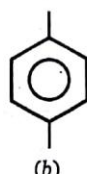
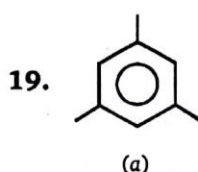
(b) $-NO_2$

(c)

(d) NO_2

17. ① ② ③ ④ NH Sulphonation is most favourable at the carbon number... .

(a) 1 (b) 2 (c) 3 (d) 4

18. Arrange the following in decreasing order of reactivity towards EAS (electrophilic aromatic substitution)

(a) $a > b > c$ (b) $c > b > a$ (c) $a > c > b$ (d) $c > a > b$

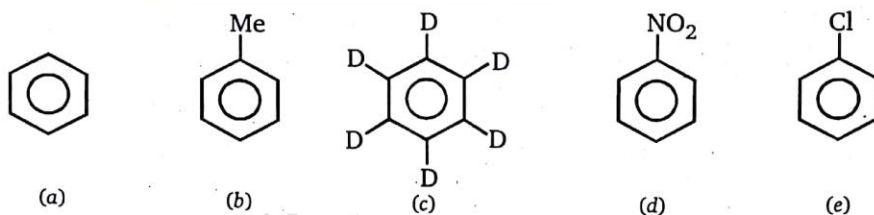
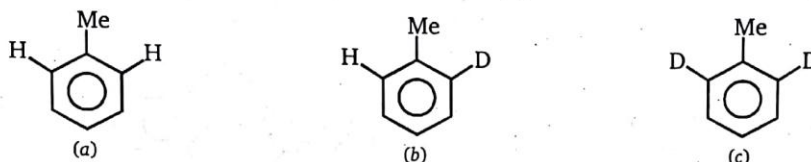
19.

Decreasing order of rate of electrophilic aromatic substitution is :

(a) $a > b > c > d$ (b) $a > c > b > d$

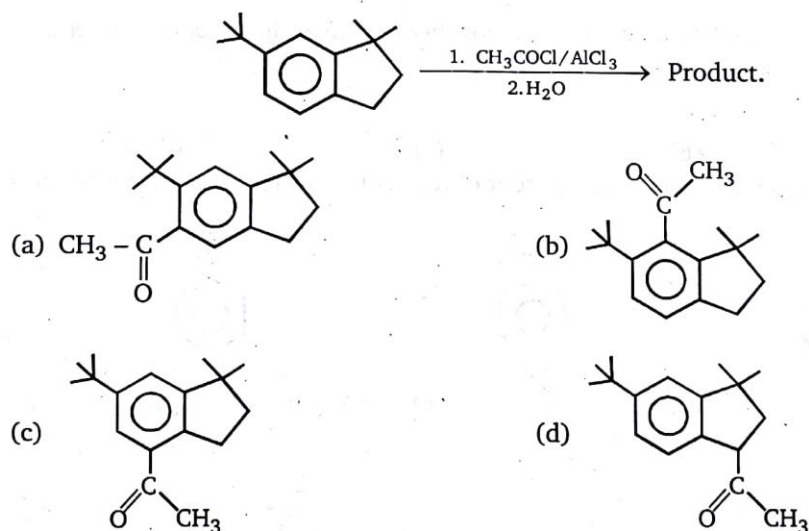
(c) $b > a > c > d$ (d) $b > c > a > d$

20. Arrange the following in increasing order of rate of Nitration:

(a) $b < c < a < d < e$
(b) $d < e < a = c < b$
(c) $d < a = c < e < b$
(d) $a < c < b < e < d$

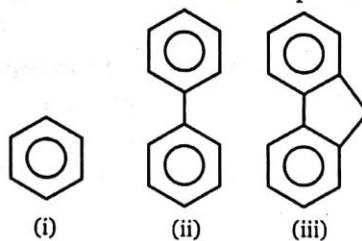
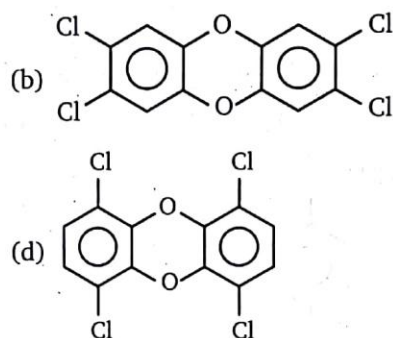
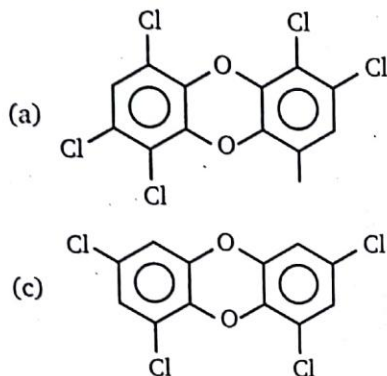
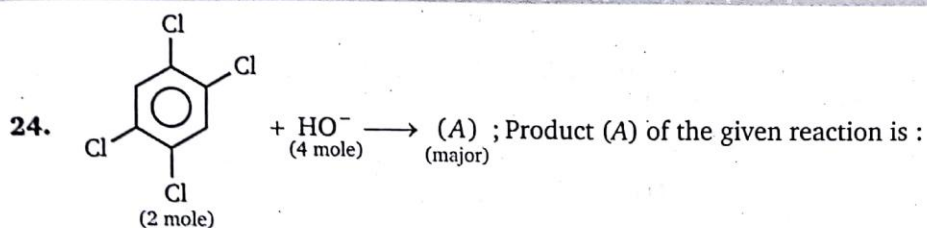
21. (a) Toluene with H, H at the ortho positions; (b) Toluene with H and D at the ortho positions; (c) Toluene with D, D at the ortho positions

The rate of nitration will be:

(a) $a > b > c$ (b) $a > c > b$ (c) $a = b = c$ (d) $c > a > b$

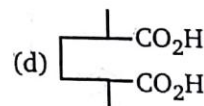
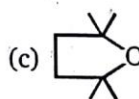
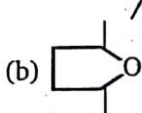
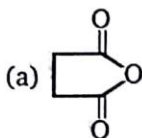
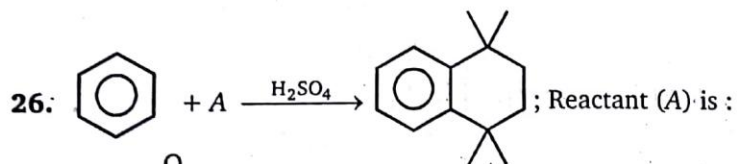
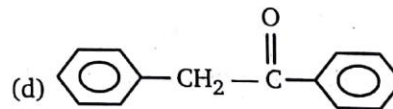
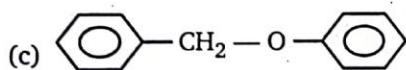
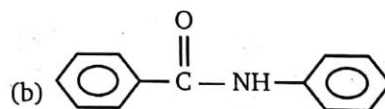
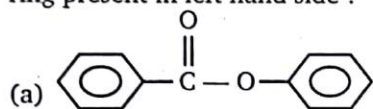
22. The major product of the reaction is

23. Arrange in their decreasing order of rate of electrophilic aromatic substitution :

(a) i > ii > iii (b) iii > ii > i (c) iii > i > ii (d) i > iii > ii

24. (2 mole) 1,2,4,5-tetrachlorobenzene + HO^- (4 mole) $\longrightarrow$ (A) (major) ; Product (A) of the given reaction is :

(a) (b) (c) (d)

25. In which of the following compound electrophilic aromatic substitution take place in phenyl ring present in left hand side ?

26. Benzene $+ A \xrightarrow{H_2SO_4}$; Reactant (A) is :

(a) (b) (c) (d) CO_2H, CO_2H

27. Which of the following compounds is the slowest to react with nitrosonium ion (NO^+)?

28. Benzene $\xrightarrow[AlCl_3]{(CH_3)_2CH-\overset{O}{\overset{||}{C}}-Cl}$ $\xrightarrow[\text{reduction}]{\text{Clemmensen}}$ $\xrightarrow[AlCl_3]{CH_3-\overset{O}{\overset{||}{C}}-Cl}$ $\xrightarrow[H_2SO_4]{NaCN}$ $\xrightarrow[H_3O^{\oplus}]{\text{Red P + HI}}$ (Ibuprofen)

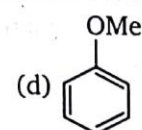
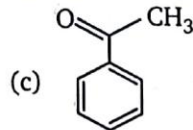
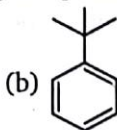
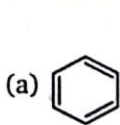
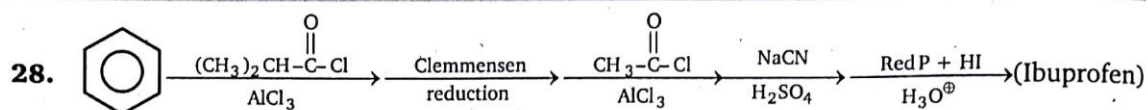
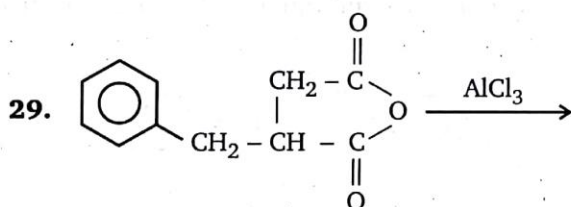
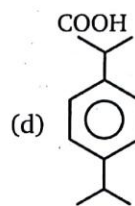
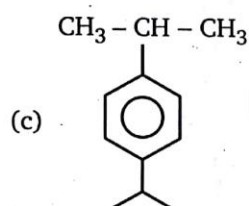
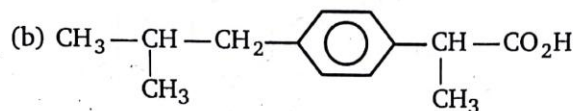
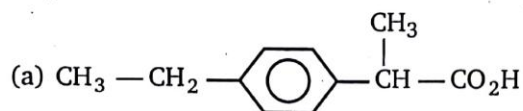
Ibuprofen is :

(a) $CH_3-CH_2-C_6H_4-CH(CH_3)-CO_2H$

(b) $CH_3-CH(CH_3)-CH_2-C_6H_4-CH(CH_3)-CO_2H$

(c) $CH_3-CH-CH_3$ attached to benzene ring, with isopropyl group at para position

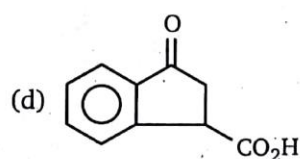
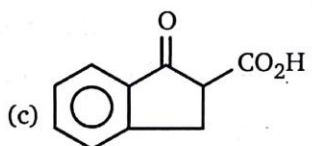
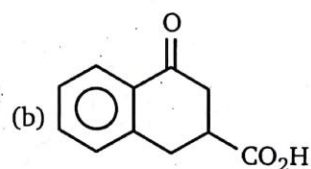
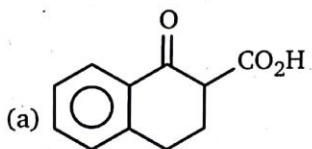
(d) COOH on CH attached to benzene ring, with isopropyl group at para position

29. $C_6H_5-CH_2-CH$ (succinic anhydride ring: $CH_2-C(=O)-O-C(=O)$) $\xrightarrow{AlCl_3}$

What is the major product of above Friedel-Craft reaction ?

(a) 1-tetralone with CO_2H at C-2

(b) 1-tetralone with CO_2H at C-3

(c) 1-indanone with CO_2H at C-2

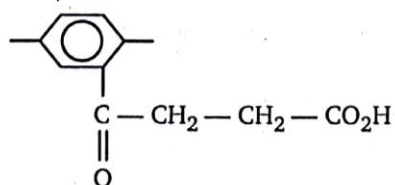
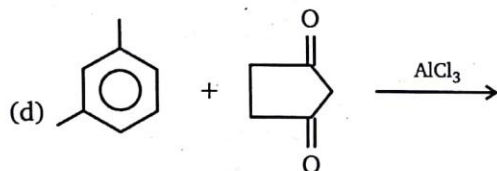
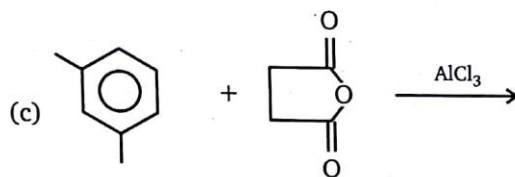
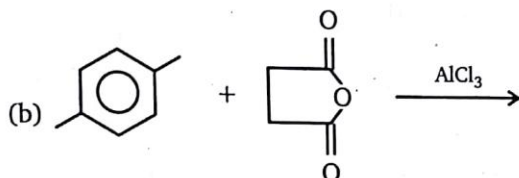
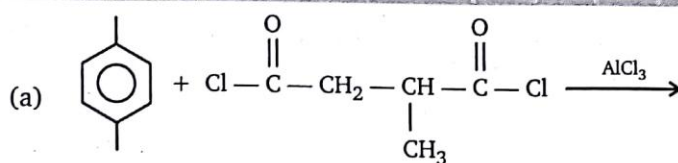
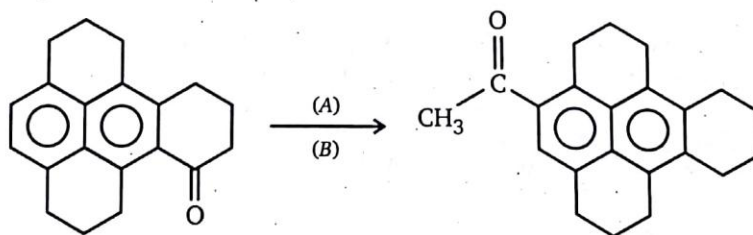
(d) 1-indanone with CO_2H at C-3

30. What combination of acid chloride or anhydride and arene would you choose to prepare given compound ?

(Dimethyl-substituted benzene ring)$-\overset{O}{\overset{||}{C}}-CH_2-CH_2-CO_2H$

(a) [p-xylene] + $Cl-\overset{O}{\overset{\|}{C}}-CH_2-\underset{CH_3}{\underset{|}{CH}}-\overset{O}{\overset{\|}{C}}-Cl \xrightarrow{AlCl_3}$

(b) [p-xylene] + [succinic anhydride] $\xrightarrow{AlCl_3}$

(c) [m-xylene] + [succinic anhydride] $\xrightarrow{AlCl_3}$

(d) [m-xylene] + [cyclopentane-1,3-dione] $\xrightarrow{AlCl_3}$

31. In the given conversion best yield will obtained with :

$\xrightarrow[(B)]{(A)}$ $CH_3-\overset{O}{\overset{\|}{C}}-$

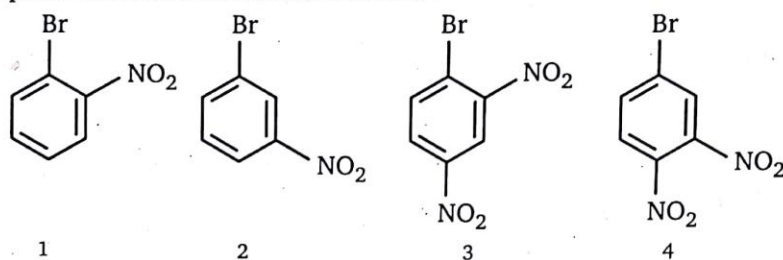
(a) $A = CH_3-\overset{O}{\overset{\|}{C}}-Cl, AlCl_3,\ B = Zn(Hg),\ HCl$

(b) $A = Zn(Hg), HCl,\ B = CH_3-\overset{O}{\overset{\|}{C}}-Cl,\ AlCl_3$

(c) $A = CH_3-CH_2-Cl,\ AlCl_3,\ B = Zn(Hg),\ HCl$

(d) $A = NH_2-NH_2/HO^-, D,\ B = CH_3-CH_2-Cl,\ AlCl_3$

32. Rank the following in order of decreasing rate of reaction with alkoxide ion ($CH_3CH_2O^-$) in a nucleophilic aromatic substitution reaction :

Br, NO_2 — 1; Br, NO_2 — 2; Br, NO_2, NO_2 — 3; Br, NO_2, NO_2 — 4

(a) 3 > 4 > 1 > 2 (b) 3 > 4 > 2 > 1 (c) 2 > 1 > 4 > 3 (d) 4 > 3 > 2 > 1

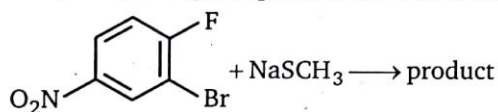
33. Identify the principal organic product of the following reaction.

O_2N, F, Br + $NaSCH_3 \longrightarrow$ product

(a) CH_3S, F, Br

(b) O_2N, SCH_3, Br

(c) CH_3S, O_2N, F, Br

(d) O_2N, F, SCH_3

34. Which position will be attacked most rapidly by the nitronium ion $(-NO_2)^+$ when the compound undergoes nitration with HNO_3/H_2SO_4 :

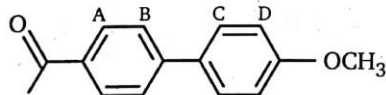
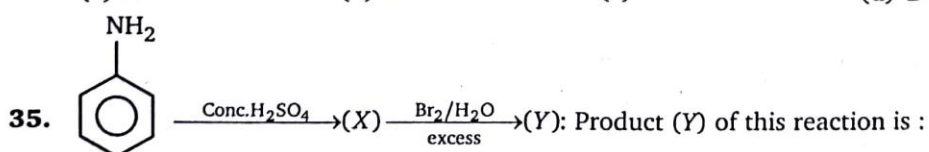
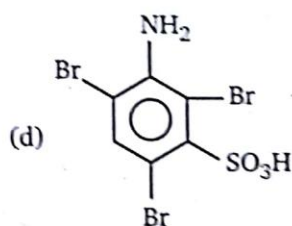
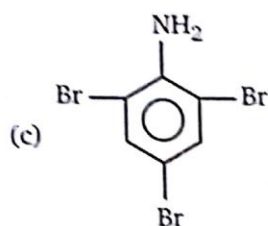
O, A, B, C, D, OCH_3

(a) A (b) B (c) C (d) D

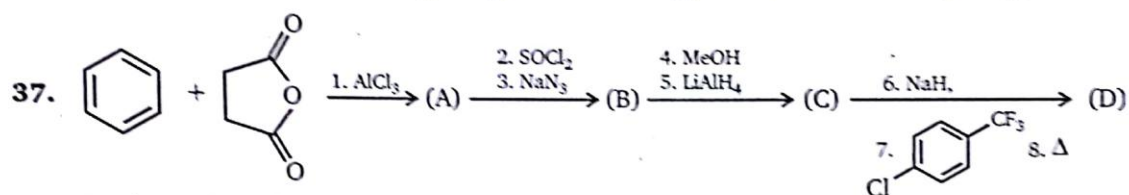
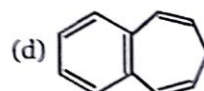
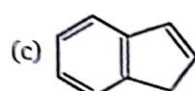
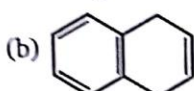
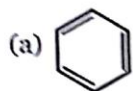
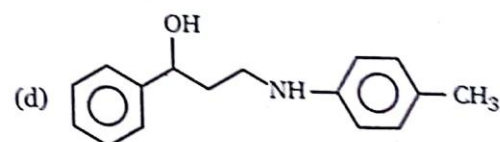
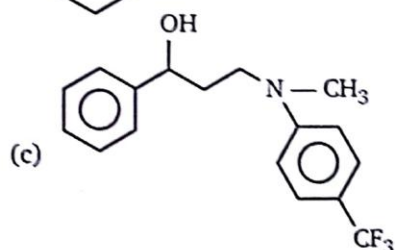
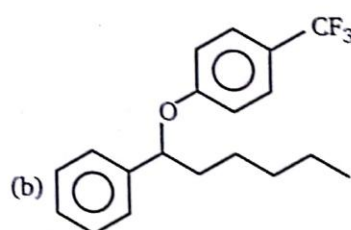
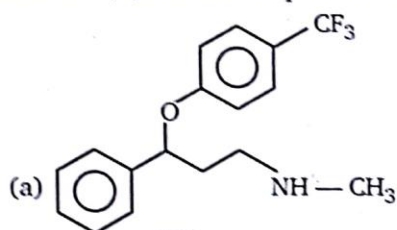
35. NH_2 $\xrightarrow{\text{Conc.}H_2SO_4} (X) \xrightarrow[\text{excess}]{Br_2/H_2O} (Y)$: Product (Y) of this reaction is :

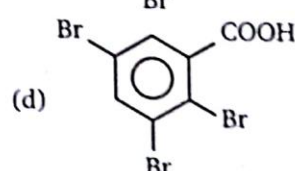
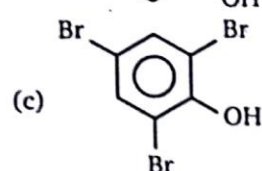
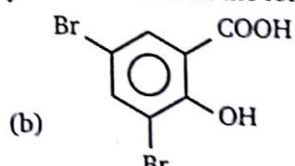
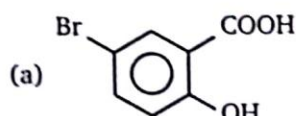
(a) NH_2, Br, SO_3H, Br

(b) NH_2, Br, Br, SO_3H

(c) (d)

36. All the hydrocarbons shown are very weak acids. One, however, is far more acidic than the others. Which one is the strongest acid ?

(a) (b) (c) (d)

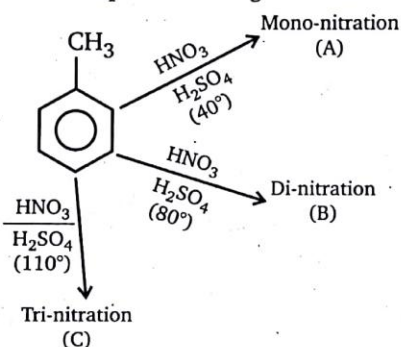
37. + $\xrightarrow{1.\ AlCl_3}$ (A) $\xrightarrow[3.\ NaN_3]{2.\ SOCl_2}$ (B) $\xrightarrow[5.\ LiAlH_4]{4.\ MeOH}$ (C) $\xrightarrow{6.\ NaH,\ 7.\ (Cl\text{-}C_6H_4\text{-}CF_3),\ 8.\ \Delta}$ (D)

Product (*D*) in above sequence is :

(a) (b) (c) (d)

38. The action of bromine water (excess) on salicylic acid results in the formation of :

(a) (b) (c) (d)

39. What is the correct order of o/p ratio when E^+ attacks the following system ?

PhF (A) PhCl (B) PhBr (C) PhI (D)

(a) A < B < C < D (b) A = B = C = D (c) D < C < B < A (d) D < B < A < C

40. How many products are capable of beings formed from toluene in each of following reaction ?

(a) A = 3, B = 6, C = 8 (b) A = 3, B = 6, C = 6

(c) A = 3, B = 6, C = 10 (d) A = 3, B = 4, C = 6

41. Nitration takes place at the which position of the given compound ?

CMe_3 (ring positions D, A, C, B) $CHMe_2$

(a) A (b) B

(c) C (d) D

42. (benzene ring with $CH_2—CO_2H$ and CO_2H) $\xrightarrow[\Delta]{Ac_2O}$?, Indentify the product.

(a) (benzene ring with $CH_2—CCl_2Ac$ and CO_2H)

(b) (benzene ring with $CH_2—CO_2H$ and CO_2Ac)

(c) (cyclic anhydride, six-membered ring, O)

(d) (phthalic anhydride, O)

43. Cl – C(=O) – C_6H_4 – Cl $\xrightarrow[AlCl_3]{C_6H_6}$ (*A*) ; Unknown (*A*) is :

(a)

(b) C = O, Cl

(c) C = O, Cl

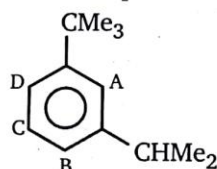
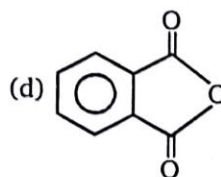
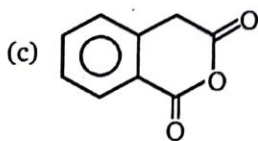
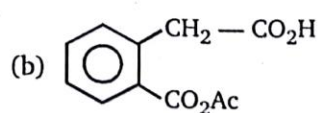
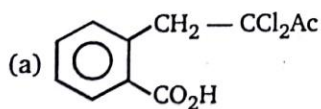
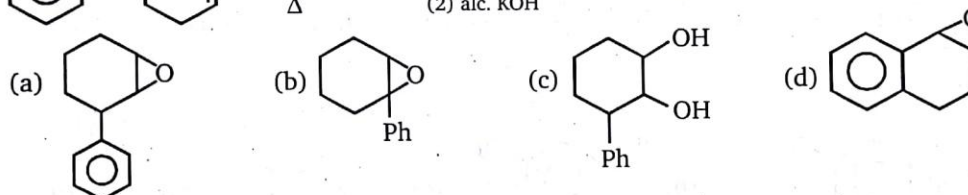
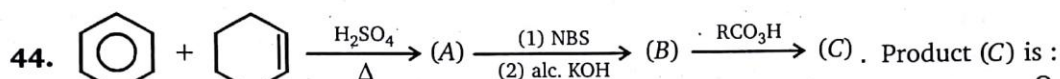
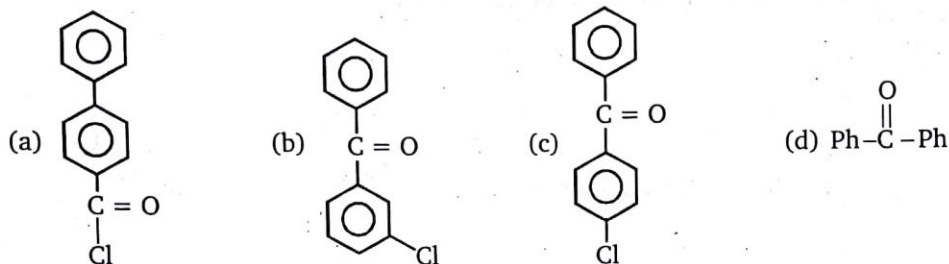
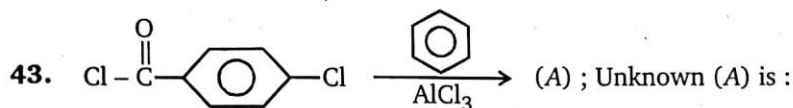
(d) Ph–C(=O)–Ph

44. C_6H_6 + cyclohexene $\xrightarrow[\Delta]{H_2SO_4}$ (*A*) $\xrightarrow[(2)\ alc.\ KOH]{(1)\ NBS}$ (*B*) $\xrightarrow{RCO_3H}$ (*C*) . Product (*C*) is :

(a) O

(b) O, Ph

(c) OH, OH, Ph

(d) O

45. The reaction of toluene with chlorine in the presence of light gives :

(a)

(b)

(c)

(d)

46. C_6H_6 + CH_3CH_2COCl $\xrightarrow[H_2O]{AlCl_3}$ (*A*) $\xrightarrow[HO^-,\ \Delta]{NH_2-NH_2}$ (*B*), Product (*B*) in this reaction is :

(a)

(b)

(c)

(d)

47. C_6H_6 + methylenecyclohexane $\xrightarrow[\Delta]{HF}$ Suitable product of this reaction is :

(a)

(b)

(c)

(d)

48. Me–C₆H₄–Cl (p-chlorotoluene) $\xrightarrow{NaSH}$ A; Product (A) of the reaction is :

(a) SH / CH_3 (p-substituted benzene) (b) no reaction (c) $CH_2 - SH$ / Cl (p-substituted benzene) (d) SH / Cl (p-substituted benzene)

49. NH_2 (aniline) $\xrightarrow[H_2O]{Br_2}$ (A) $\xrightarrow[\text{(ii) } H_3PO_2]{\text{(i) } NaNO_2/HCl}$ (B), Product (B) in this reaction is :

(a) Br, Br, Br (benzene) (b) Br, Br, Br (benzene) (c) Br, Br, Br (benzene) (d) Br (benzene)

50. 2 Cl / NO_2 (p-substituted benzene) $\xrightarrow{Na_2S}$ (A), Product (A) in this reaction is :

(a)

(b) NO_2 / S / NO_2 (c) SH / NO_2 (p-substituted benzene) (d) S / NO_2 / NO_2

51. NH_2 / CH_3 (p-substituted benzene) $\xrightarrow{NaNO_2/HCl}$ (A) $\xrightarrow[\text{(mild basic medium)}]{\text{O–H (phenol)}}$ (B) (Major), Product (B) of this reaction is :

(a) CH_3–C_6H_4–N = N – Ph

(b) OH–C_6H_4–N = N–C_6H_4–CH_3

(c) OH–C_6H_4–Ph

(d) OH–C_6H_4(meta)–N = N–C_6H_4–CH_3

52. C_6H_5–O – H $\xrightarrow{HNO_3/H_2SO_4}$ (*A*) (more volatile) + (*B*) (less volatile)

Product (*A*) of the above reaction is :

(a) OH, NO_2 (b) OH, NO_2 (c) OH, NO_2 (d) NO_2

53. NH_2–C_6H_4–NO_2 $\xrightarrow[(56-63\%)]{2ICl}$ *x* + 2HCl; Major product (*x*) in this reaction is :

(a) NH_2, I, I, NO_2 (b) NH_2, I, I, NO_2 (c) NH_2, I, I, NO_2 (d) NH_2, I, I, NO_2

54. C_6H_6 $\xrightarrow[H_2SO_4]{HNO_3}$ $C_6H_5NO_2$, van't-Hoff factor (*i*) for this reaction is :

(a) 2 (b) 3 (c) 4 (d) 5

55. $C_6H_5NH_2$ $\xrightarrow{?}$ $C_6H_5NO_2$, the missing reagent is :

(a) CF_3CO_3H (b) H_2SO_4 (c) LAH (d) $NaBH_4$

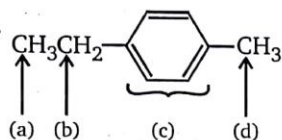
56.

above reaction is an example of Nucleophilic aromatic substitution. Which of the following halide (–X) is most readily replaced.

(a) – F (b) – Cl (c) – Br (d) – I

57. When comparing the hydrogenation of benzene with that of a hypothetical 1, 3, 5-cyclohexatriene, benzene ________ than the cyclohexatriene.

(a) absorbs 152 kJ /mol more heat (b) gives off 152 kJ/mol more heat
(c) absorbs 152kJ /mol less heat (d) gives off 152 kJ/mol less heat

58. Which of the following hydrogens is most easily abstracted on reaction with bromine free radicals, Br• ?

(a) a (b) b (c) c (d) d

59. The electrophilic aromatic substitution proceeds through a :

(a) free radical (b) sigma complex (c) benzyne (d) carbene

60. Which of the following substitution of benzene is ortho-para in electrophilic substitution and ortho-para in nucleophilic substitution ?

(a) – NO_2 (b) – NO
(c) – SO_3H (d) – SO_2Me

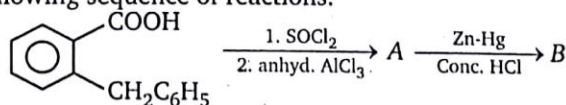
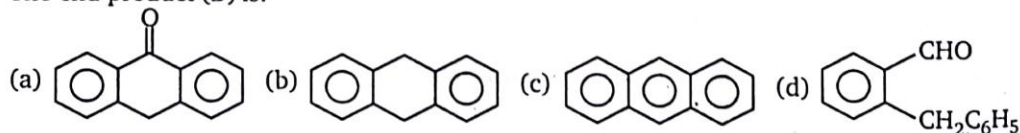
61. The number of possible isomers of dichloronitrobenzene is :

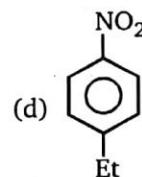
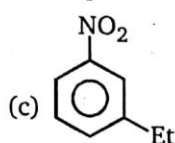
(a) 3 (b) 4 (c) 6 (d) 8

62. Which of the following is not an aromatic compound ?

(a) (b) (c) (d)

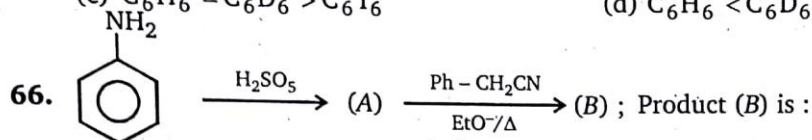
63. Consider the following sequence of reactions.

$$\text{(o-}CH_2C_6H_5\text{-benzoic acid, } COOH\text{)} \xrightarrow[\text{2. anhyd. } AlCl_3]{\text{1. } SOCl_2} A \xrightarrow[\text{Conc. HCl}]{\text{Zn-Hg}} B$$

The end product (B) is:

64. $Ph-NO_2 + Et-Cl \xrightarrow{AlCl_3} (A)$, Product (A) of the given reaction is :

(a) $Ph-NH-Et$ (b) no–reaction (c) m-nitroethylbenzene (NO_2, Et) (d) p-nitroethylbenzene (NO_2, Et)

65. In nitration of benzene by mixed acid the rate of reaction will be :

(a) $C_6H_6 = C_6D_6 = C_6T_6$ (b) $C_6H_6 > C_6D_6 > C_6T_6$

(c) $C_6H_6 = C_6D_6 > C_6T_6$ (d) $C_6H_6 < C_6D_6 < C_6T_6$

66. $C_6H_5NH_2 \xrightarrow{H_2SO_5} (A) \xrightarrow[EtO^-/\Delta]{Ph-CH_2CN} (B)$; Product (B) is :

(a) $Ph-N=C(Ph)-CN$ (b) $Ph-N=C-Ph$

(c) $Ph-N=N-Ph$ (d) $Ph-CH=CH-Ph$

67. Which of the following ring compounds obeys Huckel's rule ?

(a) $C_4H_4^{-1}$ (b) $C_4H_4^{+1}$ (c) $C_4H_4^{-2}$ (d) C_4H_4

68. Nitration of which of the following reactant gives maximum % of meta product (using HNO_3/H_2SO_4) ?

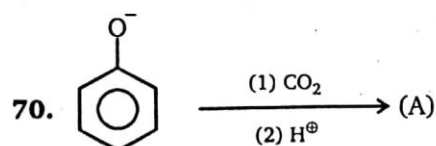
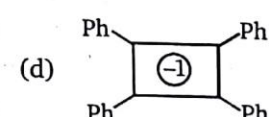
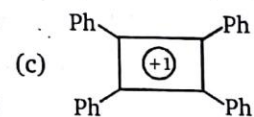
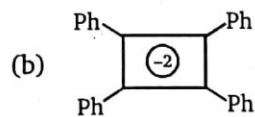
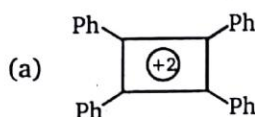
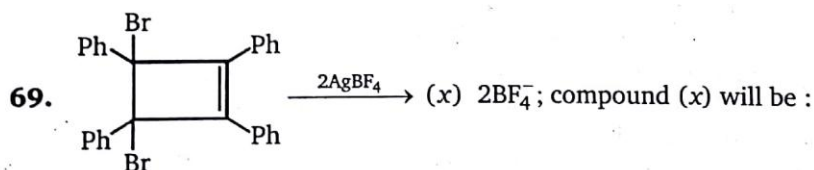
(a) Toluene (b) Aniline

(c) Benzene (d) Isopropyl benzene

69. 3,4-dibromo-1,2,3,4-tetraphenylcyclobutene $\xrightarrow{2AgBF_4} (x)\ 2BF_4^-$; compound (x) will be :

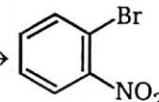
(a) tetraphenylcyclobutadiene (+2) (b) (−2) (c) (+1) (d) (−1)

70.

$C_6H_5O^- \xrightarrow[(2)\ H^{\oplus}]{(1)\ CO_2} (A)$

Which of the following is true statement about the reaction ?

(a) Ortho isomer is major if PhONa is used

(b) Para isomer is major if PhOK is used

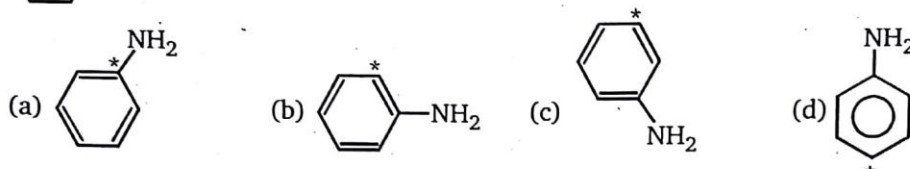
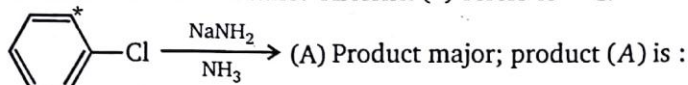
(c) Product formed is further used for preparation of drug aspirin

(d) All of these

71. Two benzyne intermediates are likely to be formed equally. Reaction with amide ion can occur in two different directions with each benzyne, giving three possible products. They are formed in a 1 : 2 : 1 ratio. Asterisk (*) refers to ^{14}C.

(a)

(b)

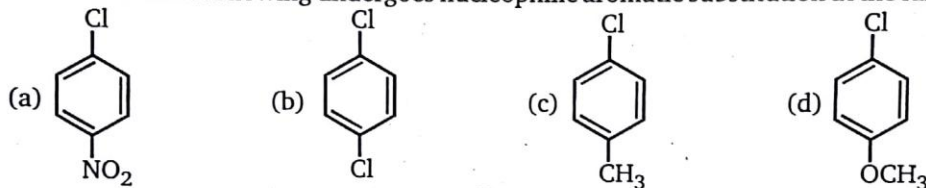
(c)

(d)

72. Which one of the following undergoes nucleophilic aromatic substitution at the fastest rate ?

(a)

(b)

(c)

(d)

73. For the reaction ; ? ⟶

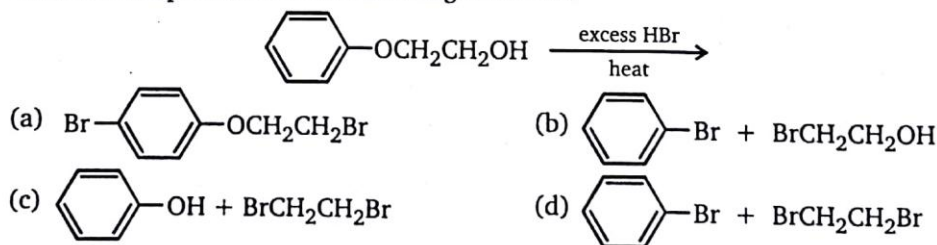
; the best combination of reactants is :

(a) $C_6H_5Br + HNO_3$, H_2SO_4 (b) $C_6H_5Br + H_2SO_4$, heat
(c) $C_6H_5NO_2 + Br_2$, $FeBr_3$ (d) $C_6H_5NO_2 + HBr$

74. The action of $AlCl_3$ in Friedel Craft's reaction is:
(a) to absorb HCl (b) to release HCl
(c) to produce electrophile (d) to produce nucleophile

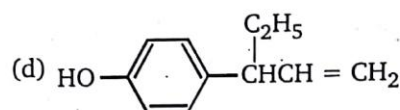
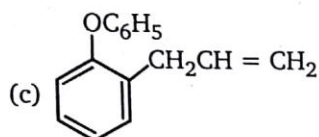
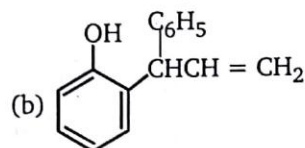
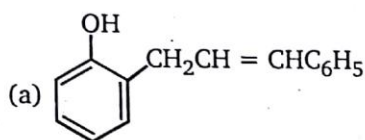
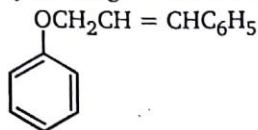
75. *n*-Butylbenzene on oxidation with hot alkanine $KMnO_4$ gives :
(a) benzoic acid (b) butanoic acid (c) benzyl alcohol (d) benzaldehyde

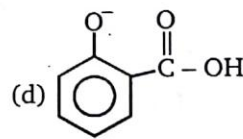
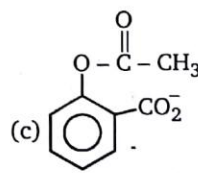
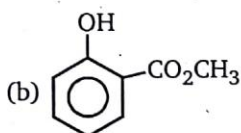
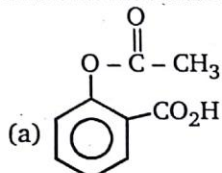
76. Which sequence of steps describes the best synthesis of 2-phenylpropene ?
(a) Benzene + 2-chloropropene , $AlCl_3$
(b) 1. Benzaldehyde ($C_6H_5CH=O$) + CH_3CH_2MgBr, diethyl ether
2. H_3O^+ 3. H_2SO_4, heat
(c) 1. Bromobenzene + Mg, diethyl ether 2. Propanal ($CH_3CH_2CH=O$)
3. H_3O^+ 4. H_2SO_4, heat
(d) 1. Bromobenzene + Mg, diethyl ether 2. Acetone [$(CH_3)_2C=O$]
3. H_3O^+ 4. H_2SO_4, heat

77. What are the products of the following reaction ?

78. What is the product obtained by heating the following allylic ether of phenol ?

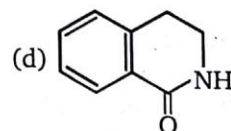
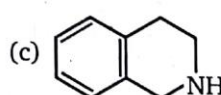
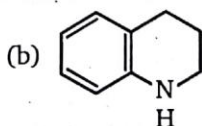
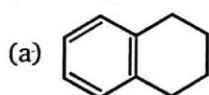
$C_6H_5OCH_2CH = CHC_6H_5$

(a) o-$HOC_6H_4CH_2CH = CHC_6H_5$ (b) o-$HOC_6H_4CH(C_6H_5)CH = CH_2$

(c) o-$C_6H_5OC_6H_4CH_2CH = CH_2$ (d) $HO-C_6H_4-CH(C_2H_5)CH = CH_2$ (para)

79. When you ingest aspirin, it passes through your stomach, which has an acidic pH, before traveling through the basic environment of your intestine. Provide the structure form as it exists in the intestine.

(a) o-$CH_3COOC_6H_4CO_2H$ (b) o-$HOC_6H_4CO_2CH_3$ (c) o-$CH_3COOC_6H_4CO_2^-$ (d) o-$^-OC_6H_4COOH$

80. Which of the following sets of reagents, used in the order shown, would be enable for the preparation of *p*-chlorophenol from *p*-chloronitrobenzene ?

(a) 1. Fe, HCl ; 2. NaOH ; 3. $NaNO_2$, H_2SO_4 ; 4. H_3PO_2
(b) 1. Fe, HCl ; 2. NaOH ; 3. $NaNO_2$, H_2SO_4 ; 4. H_2O, heat
(c) 1. Fe, HCl ; 2. NaOH ; 3. $NaNO_2$, H_2SO_4 ; 4. ethanol
(d) 1. NaOH, heat ; 2. HCl

81. Which one of the following compounds undergoes bromination of its aromatic ring (electrophilic aromatic substitution) at the fastest rate ?

82. $C_6H_5OH \xrightarrow{CH_3-CO-Cl} (P) \xrightarrow[\Delta]{\text{Anhy. } AlCl_3} (Q)$. Product (*Q*) in this reaction is :

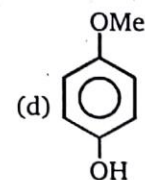
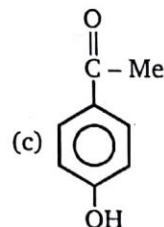
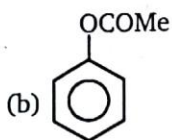
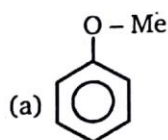
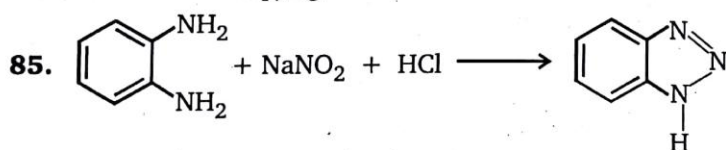
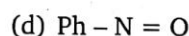
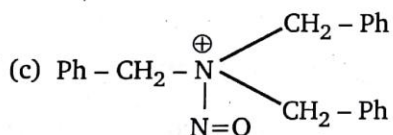
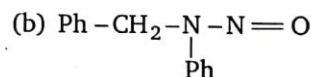
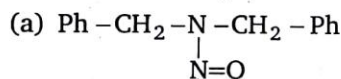
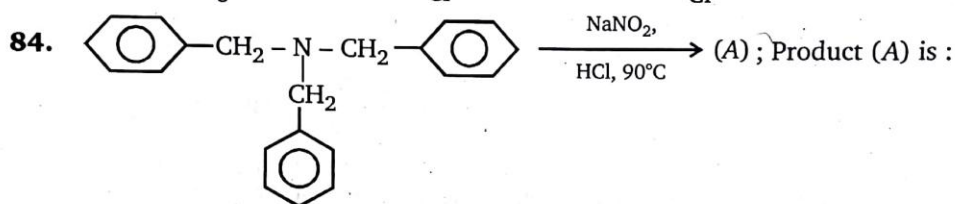
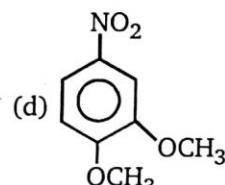
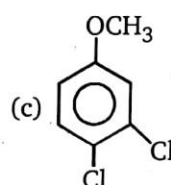
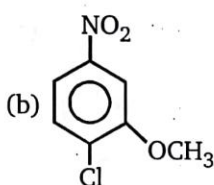
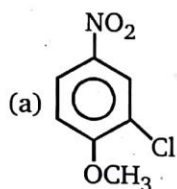
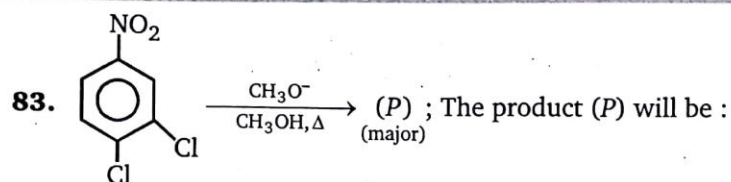
83.

$\xrightarrow[CH_3OH, \Delta]{CH_3O^-}$ (P) (major) ; The product (P) will be :

84. $C_6H_5-CH_2-\underset{\underset{C_6H_5}{|}}{\underset{CH_2}{\underset{|}{N}}}-CH_2-C_6H_5 \xrightarrow[HCl,\ 90°C]{NaNO_2,} (A)$; Product (A) is :

(a) $Ph-CH_2-\underset{\underset{N=O}{|}}{N}-CH_2-Ph$ (b) $Ph-CH_2-\underset{\underset{Ph}{|}}{N}-N=O$

(c) $Ph-CH_2-\overset{\oplus}{N}(N=O)(CH_2-Ph)_2$ (d) $Ph-N=O$

85. o-$C_6H_4(NH_2)_2$ $+ NaNO_2 + HCl \longrightarrow$ (benzotriazole, ring N=N–N–H)

This reaction is example of :

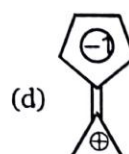
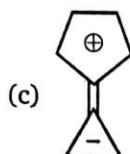
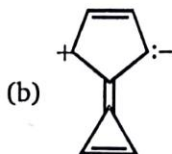
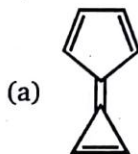
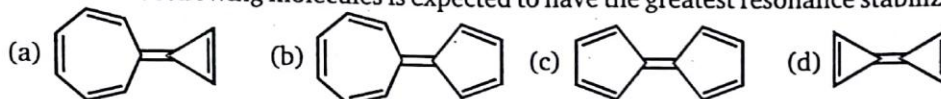
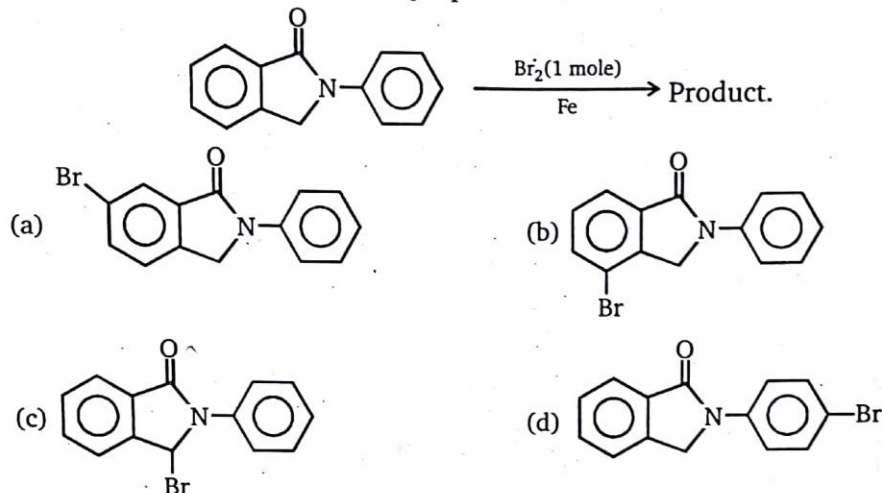
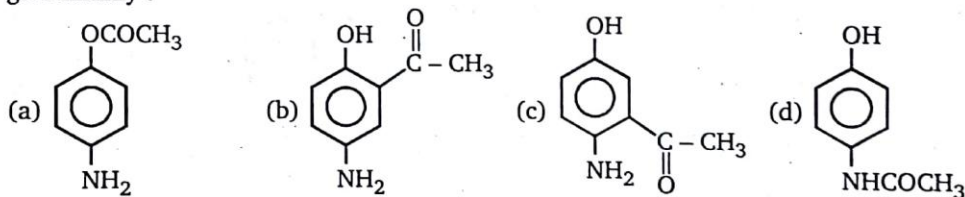
(a) Intermolecular C – N coupling (b) Intramolecular C – N coupling

(c) Intermolecular N – N coupling (d) Intramolecular N – N coupling

86. The total number of isomeric trimethylbenzene is :

(a) 2 (b) 3 (c) 4 (d) 6

87. Caliene, C_7H_6, is expected to be a fairly polar aromatic molecule. Which of the following resonance forms contributes to the greatest extent towards the real structure (resonance hybrid) of the molecule ?

(a)   (b)   (c)   (d)

88. Which of the following molecules is expected to have the greatest resonance stabilization ?

89. In the reaction given below, the major product formed is :

90. *p*-aminophenol reacts with one equivalent of acetyl chloride in the presence of pyridine to give mainly :

91. Which of the following reactions can be used to prepare acetophenone ?

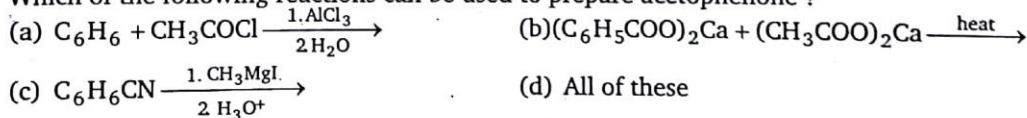
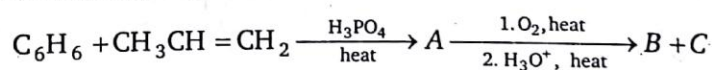
(a) $C_6H_6 + CH_3COCl \xrightarrow[2 H_2O]{1. AlCl_3}$

(b) $(C_6H_5COO)_2Ca + (CH_3COO)_2Ca \xrightarrow{heat}$

(c) $C_6H_6CN \xrightarrow[2. H_3O^+]{1. CH_3MgI}$

(d) All of these

92. Consider the following sequence of reactions.

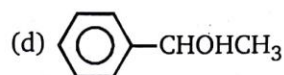
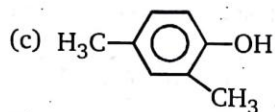
$$C_6H_6 + CH_3CH = CH_2 \xrightarrow[heat]{H_3PO_4} A \xrightarrow[2. H_3O^+,\ heat]{1. O_2, heat} B + C$$

The products (*B*) and (*C*) are :

(a) benzaldehyde and acetaldehyde
(b) benzoic acid and acetic acid
(c) phenol and propionaldehyde
(d) phenol and acetone

93. An organic compound having the molecular formula $C_8H_{10}O$ on being heated with I_2 and dilute NaOH gives a yellow precipitate. The expected compound is :

(a) $C_6H_5CH_2CH_2OH$

(b) $CH_3-C_6H_4-CH_2OH$

(c) $H_3C-C_6H_3(CH_3)-OH$ (d) $C_6H_5-CHOHCH_3$

94. The product (*B*) of the reaction sequence is :

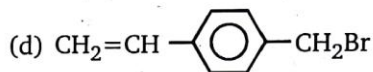
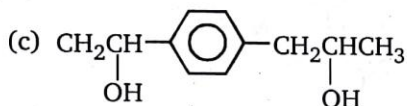
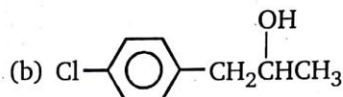
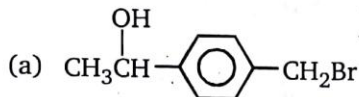
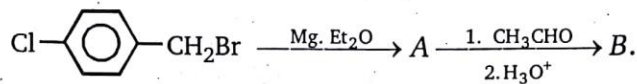
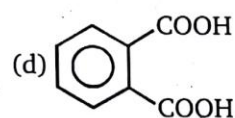
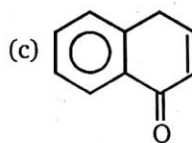
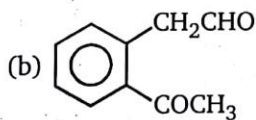
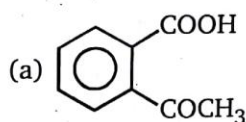
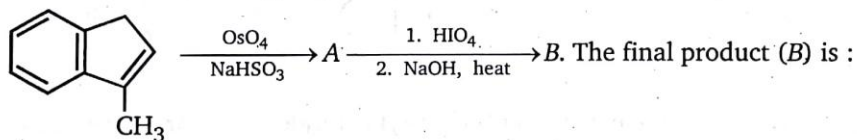
$$Cl-C_6H_4-CH_2Br \xrightarrow{Mg.\ Et_2O} A \xrightarrow[2.\ H_3O^+]{1.\ CH_3CHO} B.$$

(a) $CH_3CH(OH)-C_6H_4-CH_2Br$ (b) $Cl-C_6H_4-CH_2CH(OH)CH_3$

(c) $CH_2CH(OH)-C_6H_4-CH_2CH(OH)CH_3$ (d) $CH_2{=}CH-C_6H_4-CH_2Br$

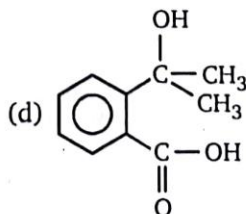
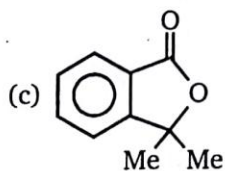
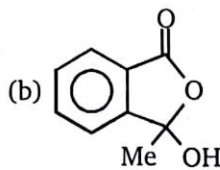
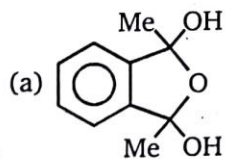
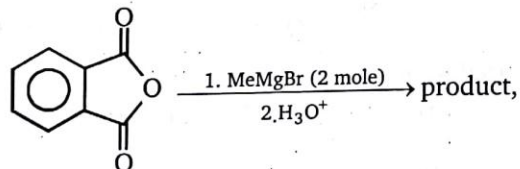
95. Consider the following sequence of reactions.

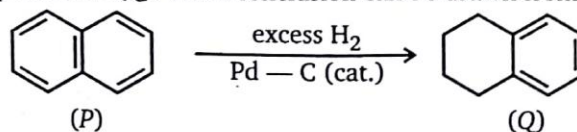
(3-methylindene, CH_3) $\xrightarrow[NaHSO_3]{OsO_4} A \xrightarrow[2.\ NaOH,\ heat]{1.\ HIO_4} B$. The final product (*B*) is :

(a) $C_6H_4(COOH)(COCH_3)$ (b) $C_6H_4(CH_2CHO)(COCH_3)$ (c) (bicyclic enone, O) (d) $C_6H_4(COOH)(COOH)$

96. For the reaction, the product expected is :

(phthalic anhydride: O, O, O) $\xrightarrow[2.\ H_3O^+]{1.\ MeMgBr\ (2\ mole)}$ product,

(a) (Me, OH; O; Me, OH) (b) (O; O; Me, OH)

(c) (O; O; Me, Me) (d) $C_6H_4[C(OH)(CH_3)CH_3][C(=O)-OH]$

97. Hydrogenation of naphthalene (P) with excess hydrogen gas stops cleanly at 1, 2, 3, 4-tetrahydronaphthalene (Q). What conclusion can be drawn from this experiment ?

(P) (Q)

(a) the hydrogenation of P is exothermic

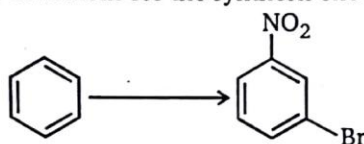
(b) one aromatic ring of P is more reactive than the aromatic ring of Q

(c) one aromatic ring of P is less reactive than the other ring of Q

(d) reduction of the first C = C of P is faster than reduction of the second or third C = C

98. Suggest the best reaction conditions for the synthesis shown below.

NO_2

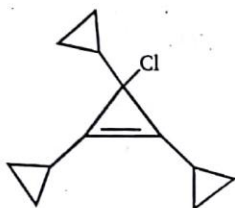
Br

(a) (1) HNO_3, H_2SO_2; then (2) Br_2

(b) (1) Br_2; then (2) HNO_3, H_2SO_2

(c) (1) CH_3Br, $AlBr_3$; then (2) HNO_3, H_2SO_3

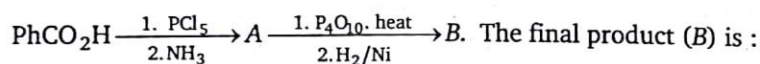
(d) HNO_3, H_2SO_2, then (2) Br_2, $FeBr_3$

99.

Cl

In the above compound Cl will liberated easily in the form of :

(a) $Cl^{\oplus}$ (b) Cl^- (c) $Cl^{\bullet}$ (d) Cl^{2+}

100. Consider the following sequence of reactions:

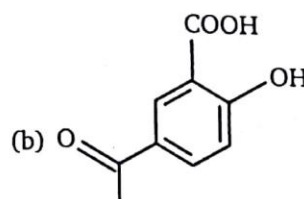
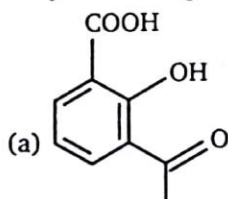
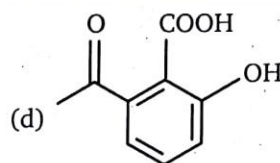
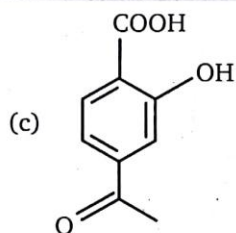
$$PhCO_2H \xrightarrow[2.\,NH_3]{1.\ PCl_5} A \xrightarrow[2.\,H_2/Ni]{1.\ P_4O_{10}.\ heat} B.$$ The final product (B) is :

(a) benzonitrile (b) benzylamine (c) aniline (d) benzamide

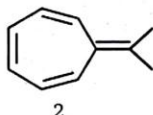
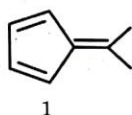
101. The major product of the acetylation of salicylic acid with Ac_2O/H^+ followed by heating with anhydrous $AlCl_3$ is :

(a)

(b) COOH, OH, O

(c) [structure: benzene ring with COOH, OH ortho, and acetyl (C=O, CH3) para to COOH]

(d) [structure: benzene ring with COOH, OH and acetyl on adjacent positions]

102. Which one of the following statements is **True:**

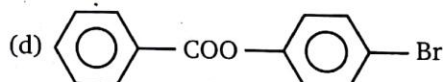
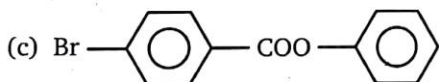
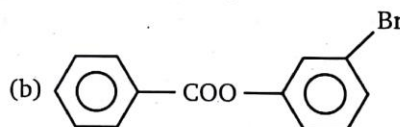
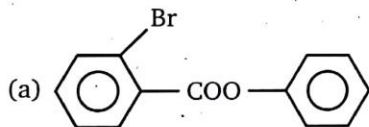
1 2

(a) PhLi adds to both compounds with equal ease
(b) PhLi does not add to either of the compounds
(c) PhLi reacts readily with 1 but does not add to 2
(d) PhLi reacts readily with 2 but does not add to 1

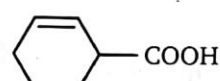
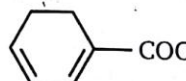
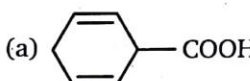
103. The major product expected from the mono-bromination of phenyl benzoate is :

(a) o-Br–C₆H₄–COO–C₆H₅ (Br ortho on benzoyl ring)

(b) C₆H₅–COO–C₆H₄–Br (Br meta on phenyl ring)

(c) Br–C₆H₄–COO–C₆H₅ (Br para on benzoyl ring)

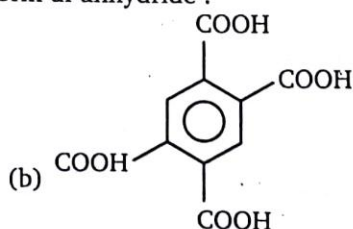
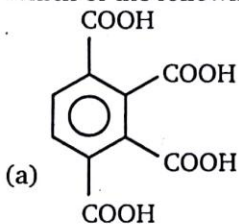
(d) C₆H₅–COO–C₆H₄–Br (Br para on phenyl ring)

104. The Birch reduction of benzoic acid gives :

(a) —COOH (b) —COOH (c) —COOH (d) —COOH

105. The decreasing order of reactivity of meta-nitrobromobenzene (I), 2,4,6-trinitrobromobenzene (II), para-nitrobromobenzene (III), and 2,4-dinitrobromobenzene (IV) towards HO^- ions is :

(a) I > II > III > IV (b) II > IV > III > I (c) IV > II > III > I (d) II > IV > I > III

106. Which of the following tetracarboxylic acid form di-anhydride :

(a) COOH, COOH, COOH, COOH (1,2,3,4-benzenetetracarboxylic acid)

(b) COOH, COOH, COOH, COOH (1,2,4,5-benzenetetracarboxylic acid)

(c) neither (a) nor (b)

(d) both (a) and (b)

107. CO_2H, OH (salicylic acid) $\xrightarrow{2I-Cl}$ (*A*); unknown (*A*) is :

(a) O, C — I, I

(b) CO_2H, OH, Cl, Cl

(c) CO_2H, OH, I, I

(d) CO_2H, I, OH, I

108. $Ph-NH_2 + Ph_3COH \xrightarrow{H^+/D} \underset{(major)}{P}$ (not a N-derivative), Product (*P*) is :

109. Deduce structure of (*A*).

(*A*) $C_8H_{10} \xrightarrow{KMnO_4} (B)\ C_8H_6O_4 \xrightarrow[Fe]{Br_2} C_8H_5BrO_4\,(C)$ (one-product only) :

110. The deamination of $Ph_2C(OH)CH_2NH_2$ with $NaNO_2-HCl$ gives a product (*P*), which on oxidation gives benzoic acid only. Identify the product (*P*).

(a) $Ph-CH_2-CH_2-Ph$

(b) $Ph-\overset{O}{\overset{\|}{C}}-CH_2-Ph$

(c) $Ph-\overset{O}{\overset{\|}{C}}-\overset{O}{\overset{\|}{C}}-Ph$

(d) $Ph-CH_2-NH-Ph$

111. $Ph-CO_2H \xrightarrow{SOCl_2} A \xrightarrow{Me_2NH} B \xrightarrow{(C)} Ph-CHO$, unknown reagent (*C*) is :

(a) $LiAlH_4$

(b) $NaBH_4$

(c) $LiAlH_4(t\text{-}BuO)_3$

(d) PCC/CH_2Cl_2

112. 1,2,4-triethylbenzene $\xrightarrow[AlCl_3]{CH_3-\overset{O}{\overset{\|}{C}}-Cl}$ (A) (80%) $\xrightarrow[\text{triethylene glycol. heat}]{NH_2-NH_2,\ NaOH}$ (B) (73%)

Product (B) is :

(a) (b) (c) (d)

113. $C_6H_5(CH_2)_5\overset{O}{\overset{\|}{C}}-Cl \xrightarrow[CS_2]{AlCl_3} \underset{C_{12}H_{14}O}{(A)} \xrightarrow[H_3O^{\oplus}]{KMnO_4,\ D} (B)$; Compound (B) is :

(a) $C_6H_5-\overset{\|}{\underset{O}{C}}-(CH_2)_4-CO_2H$

(b) $C_6H_5-CO_2H$

(c) $C_6H_4(CO_2H)_2$ (ortho)

(d) phthalic anhydride

114. $C_6H_5R \xrightarrow[H_2SO_4]{HNO_3}$ o-$R-C_6H_4-NO_2$ (ortho) + p-$R-C_6H_4-NO_2$

In the above reaction *o/p* ratio will be highest when :

(a) $R = -CH_3$

(b) $R = -CH_2-CH_3$

(c) $R = -CHMe_2$

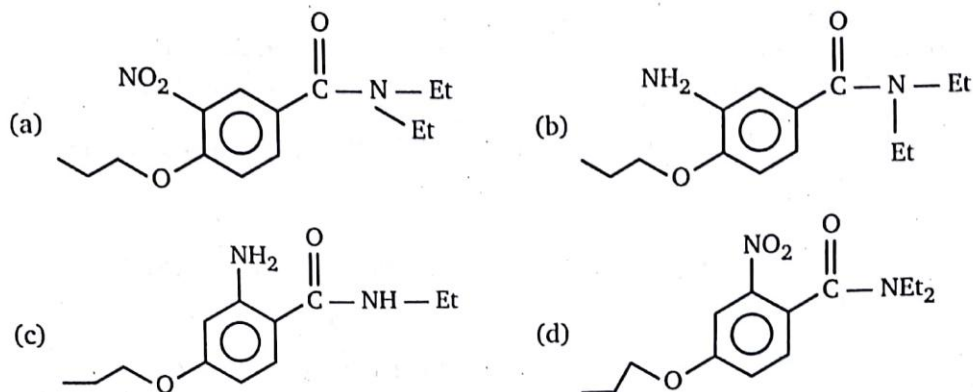
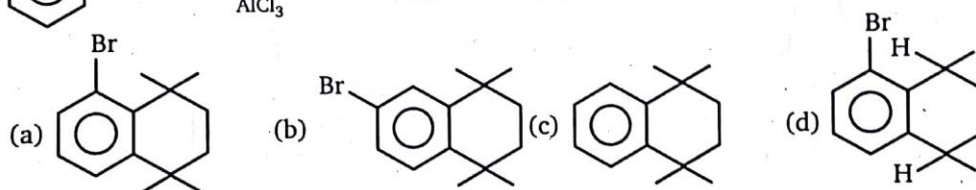
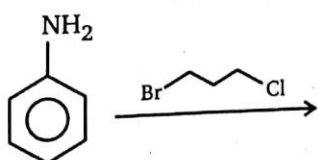
(d) $R = -CMe_3$

115. (HO–C_6H_4–CO_2H) $\xrightarrow{HNO_3}$ (1) $\xrightarrow[n-PrCl]{Base}$ (2) $\xrightarrow{SOCl_2}$ (3) $\xrightarrow[(2)\ H_2/Pd]{(1)\ Et_2NH}$ (4)

product (4) in the above reaction is :

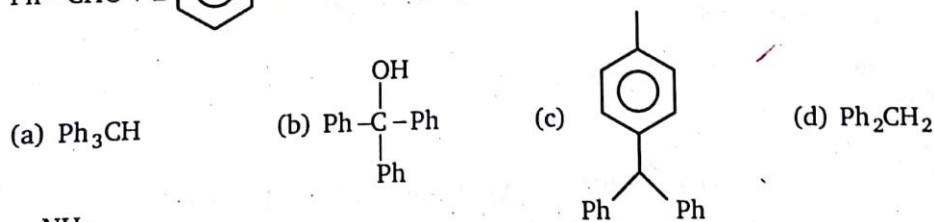
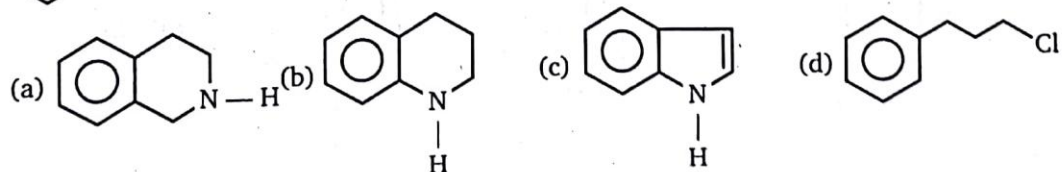
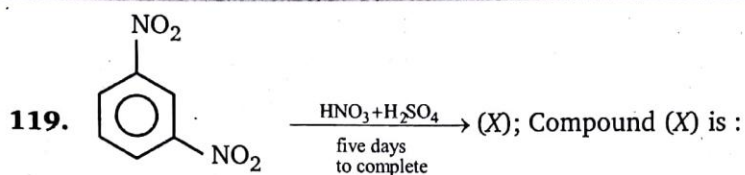
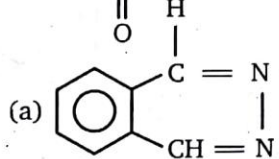
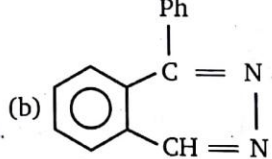
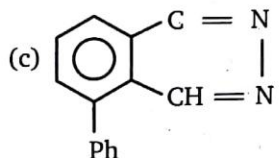
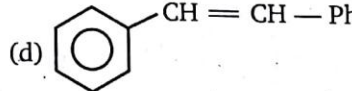
(a) NO_2, O-propyl, C(=O)–N–Et, Et
(b) NH_2, O-propyl, C(=O)–N–Et, Et
(c) NH_2, O-propyl, C(=O)–NH–Et
(d) NO_2, O-propyl, C(=O)–NEt_2

116. (Bromobenzene, Br) $\xrightarrow[AlCl_3]{\text{Cl, Cl}}$ (*A*); Product (*A*) of the reaction is :

(a) Br (b) Br (c) (d) Br, H, H

117. Ph – CHO + 2 (benzene) $\xrightarrow{H_2SO_4}$ major product of this reaction is :

(a) Ph_3CH (b) Ph–C(OH)(Ph)–Ph (c) Ph, Ph (d) Ph_2CH_2

118. (NH_2, aniline) $\xrightarrow{\text{Br}\frown\frown\text{Cl}}$ (*A*); Product (*A*) of this reaction is :

(a) N – H (b) N–H (c) N–H (d) Cl

119. m-Dinitrobenzene (NO_2 at positions 1 and 3) $\xrightarrow[\text{five days to complete}]{HNO_3 + H_2SO_4}$ (X); Compound (X) is :

(a) 1,2,4-Trinitrobenzene (b) 1,3,5-Trinitrobenzene
(c) 1,2,3 -Trinitrobenzene (d) Tri-nitro toluene (TNT)

120. γ-Butyrolactone $\xrightarrow[\text{(ii) } SOCl_2]{\text{(i) HCl}}$ (A) $\xrightarrow[AlCl_3]{Ph-H}$ (B) $\xrightarrow{KOH/MeOH}$ (C); Compound (C) is :

(a) $Ph-CH_2-\overset{O}{\overset{\|}{C}}-$cyclopropyl (b) $Ph-CH=CH-\overset{O}{\overset{\|}{C}}-CH_3$

(c) $Ph-\overset{O}{\overset{\|}{C}}-$cyclopropyl (d) $Ph-\overset{O}{\overset{\|}{C}}-CH=CH-CH_3$

121. Phthalic anhydride $\xrightarrow[AlCl_3]{C_6H_6}$ (A) $\xrightarrow[\text{(ii) } H_2/Pd-BaSO_4]{\text{(i) } PCl_5}$ (B) $\xrightarrow{NH_2-NH_2}$ (C); Compound (C) is :

(a) Benzo-fused ring: $-\overset{H}{\overset{|}{C}}=N-N=CH-$ (phthalazine)
(b) Benzo-fused ring: $-\overset{Ph}{\overset{|}{C}}=N-N=CH-$ (1-phenylphthalazine)
(c) Benzo-fused ring: $-C=N-N=CH-$, with Ph on the benzene ring
(d) $C_6H_5-CH=CH-Ph$

122. Resorcinol (OH at positions 1 and 3) $\xrightarrow[H_3O^+]{\text{(i) aq } NaHCO_3\text{/boil}}$ (A) (major), Product (A) in this reaction is :

(a) Benzene ring with OH, OH (meta) and CHO (between/para) — 2,4-dihydroxybenzaldehyde
(b) Benzene ring with OH, OH and CO_2H — 2,4-dihydroxybenzoic acid
(c) Benzene ring with OH, OH, OH — 1,2,4-trihydroxybenzene
(d) No reaction

123.

, Identify position where attack of (ArO^-) is favourable.

(a) i (b) ii (c) iii (d) iv

124. (o-nitrophenyl disulfide: NO_2, S — S, NO_2) $\xrightarrow{Cl_2}$ (A), Product (A) of this reaction is :

(a) SH, NO_2 (b) S — Cl, NO_2 (c) SH, NO_2 (d) NO_2, NO_2

125. (C(=O)—Me on benzene) $\xrightarrow[H_2SO_4]{HNO_3}$ (A) $\xrightarrow[HCl]{Zn(Hg)}$ (B), Product (B) of this reaction is :

(a) CH_2 — Me, NO_2 (b) CH_2 — Me, NH_2 (c) O=C — Me, NO_2 (d) CH_2 — Me, NO_2

126. (Me on benzene) + HN = CH – Cl $\xrightarrow{AlCl_3}$ (A) $\xrightarrow{H_3O^+}$ (B), Product (B) of this reaction is :

(a) Me, CHO (b) CH_3, CHO (c) No-reaction (d) O=C — Me

127. (CH_2CO_2H on naphthalene) $\xrightarrow[H^+]{EtOH}$ $\xrightarrow[\text{(ii) MeI}]{\text{(i) NaH}}$ $\xrightarrow[\text{(ii) } H^+]{\text{(i) NaOH}}$ $\xrightarrow[\text{(ii) } AlCl_3]{\text{(i) } SOCl_2}$; Product

End product of the above reaction is :

(a) (b)

(c) (d)

128. $Ph-NH_2 \xrightarrow{CH_3-Cl\ (2mole)} (A) \xrightarrow{Ph-\overset{\oplus}{N}_2\overset{-}{Cl}} (B)$ (major)
Butter yellow

Product of the above reaction is :

(a) Me — N — Me, N = N — Ph (b) Me — N — Me, N = N — Ph

(c) Me — N — Me, N = N — Ph (d) Me, Me — $\overset{\oplus}{N}$ — N = N — Ph

129. *p*-Toluedine reacts with benzene diazonium chloride to form compound, which on boiling with aq. H_2SO_4 give .... products :

(a) 3 (b) 2 (c) 4 (d) 5

130. NO_2, Cl $\xrightarrow{aq\,NH_3} (A) \xrightarrow[H_2O]{Br_2} (B) \xrightarrow[(ii)\,H_3PO_2]{(i)\,NaNO_2 + HCl} (C)$

Product (*C*) of the above reaction is :

(a) NO_2, Br, Br (b) NO_2, Br, Br (c) NO_2, Br, Br (d) NO_2, Br, Br

131. Benzene $\xrightarrow[\text{H}_2\text{O}_2 \text{ (Fenton's reagent)}]{\text{Fe}^{+2}}$ (A) $\xrightarrow[\text{H}_2\text{O}]{\text{Br}_2}$ (B) ($\equiv$ 100%) ; Major product (B) of this reaction is :

(a) OH, Br (ortho)
(b) OH, Br (meta)
(c) CH, Br (para)
(d) OH, Br, Br, Br (2,4,6)

132. Br, NO_2, Br (1-Br, 2-NO_2, 4-Br) $\xrightarrow{\text{HO}^-}$ (A) ; Product of the given reaction is :

(a) Br, NO_2, OH
(b) OH, NO_2, Br
(c) Br, NO_2, HO, Br
(d) Br, NO_2, HO

133. NH_2 (aniline) $\xrightarrow{(CH_3CO)_2O}$ (A) $\xrightarrow[\text{H}_2\text{SO}_4]{\text{HNO}_3}$ (B) $\xrightarrow[\text{H}_2\text{O}]{\text{H}^+}$ (C), Product (C) of this reaction is :

(a) NH_2, NO_2 (meta)
(b) NH_2, NO_2 (para)
(c) NO_2, NO_2 (meta)
(d) NO_2, NO_2 (para)

134. Nitrobenzene $\xrightarrow[\text{Fe}]{Br_2\ (2\text{mole})}$ (A) (major) ; Product (A) will be :

(a) 1-NO_2, 3-Br, 4-Br (b) 1-NO_2, 3-Br, 5-Br (c) 1-NO_2, 2-Br, 4-Br (d) 1-NO_2, 2-Br, 6-Br

135. Ethylbenzene $\xrightarrow[\text{(ii) } H_2SO_4]{\text{(i) } HNO_3}$ (A) (Di-nitro product) $\xrightarrow{KMnO_4/\Delta}$ (B) $\xrightarrow{SOCl_2}$ (C); Product (C) of this reaction is :

(a) COCl with NO_2 (meta) and NO_2 (meta') (b) O=C—Cl with NO_2 (ortho) and NO_2 (para) (c) Ethyl with NO_2 (ortho) and NO_2 (para) (d) Ethyl with NO_2 (meta) and NO_2 (para)

136. p-Chloronitrobenzene $\xrightarrow{CH_3—NH—CH_3}$ (A) $\xrightarrow[\text{HCl}]{\text{Fe}}$ (B) ; Product (B) of this reaction is :

(a) $(CH_3)_2N$— with NH_2 (para)

(b) $(CH_3)_2N$— with NH_2 (meta)

(c) $(CH_3)_2N$— with NH_2 (ortho)

(d) None of these

137. $(A) \xrightarrow[\text{(ii) } NH_3]{\text{(i) } SOCl_2} (B) \xrightarrow{Br_2 + KOH}$ [benzene ring with OH and NH_2 ortho]

Which of the following compound on hydrolysis gives reactant (A) :

(a) [2-nitrophenyl–C(=O)–O–2-hydroxyphenyl; labels: O, C, O, NO_2, HO]

(b) [2-hydroxyphenyl–C(=O)–O–2-nitrophenyl; labels: O, C, O, HO, NO_2]

(c) NO_2–[4-nitrophenyl–C(=O)–O–phenyl; labels: O, C, O]

(d) [3-nitrophenyl–C(=O)–O–3-hydroxyphenyl; labels: O, C, O, NO_2, OH]

138. [MeO-substituted tetrahydronaphthalene] $\xrightarrow{HNO_3/H_2SO_4} (A);$

Product (A) of the above reaction is :

(a) [tetrahydronaphthalene with NO_2, NO_2, MeO]

(b) [naphthalene with NO_2, MeO]

(c) [tetrahydronaphthalene with NO_2, MeO]

(d) [tetrahydronaphthalene with MeO on aromatic ring and NO_2 on saturated ring]

139. [Me–C₆H₄–N(H)–C(=O)–CH₃; labels: Me, O, N, H] $\xrightarrow[CS_2]{Br_2}$; Product of the reaction is :

(a) [ring with Br, methyl, NH–C(=O)CH₃; labels: Br, O, NH]

(b) [4-methylphenyl–NH–C(=O)–CH_2–Br; labels: O, NH, $CH_2 - Br$]

(c) [4-(CH_2–Br)phenyl–NH–C(=O)CH₃; labels: $CH_2 - Br$, O, NH]

(d) [ring with methyl, NH–C(=O)CH₃, Br ortho to NH; labels: O, NH, Br]

140. p-nitrophenol (OH, NO_2) $\xrightarrow[Pd]{H_2}$ (A) $\xrightarrow{\text{acetic anhydride}}$ (B) (Paracetamol) ; Product (B) of this reaction is :

(a) 4-aminophenyl acetate ($O-\overset{O}{\overset{||}{C}}-CH_3$, NH_2) (b) OH, HN–C(=O)CH₃ (c) OH, $\overset{O}{\overset{||}{C}}-CH_3$, NH_2 (d) NH_2, OH

141. Benzene + succinic anhydride $\xrightarrow[\text{2.2 equivalents}]{AlCl_3}$ (A) $\xrightarrow[HCl]{Zn(Hg)}$ (B) $\xrightarrow{H_3PO_4}$ (C) ;

(succinic anhydride)

Product (C) of the above reaction is :

(a) O (b) O (c) OH (d) OH

142. Benzene + 3-methylbut-2-enoic acid ($\overset{O}{\overset{||}{C}}$–O–H) $\xrightarrow{AlCl_3}$ Product; 82% yield

Product of the above Friedel-Craft reaction is :

(a) CO_2H (b) $\overset{O}{\overset{||}{C}}$ (c) CO_2H (d)

143. Which of the following 2-halo nitrobenzene is most reactive towards nucleophilic aromatic substitution ?

(a) 2-F nitrobenzene (F, NO_2) (b) 2-Cl nitrobenzene (Cl, NO_2) (c) 2-Br nitrobenzene (Br, NO_2) (d) 2-I nitrobenzene (I, NO_2)

144. Choose the best method to prepare given compound :

CH_3–C(CH_3)(CH_3)– benzene ring – NO_2 (para)

(a) Benzene $\xrightarrow[(2)\,Me_3CCl/AlCl_3]{(1)\,HNO_3+H_2SO_4}$

(b) Benzene $\xrightarrow[(2)\,HNO_3/H_2SO_4]{(1)\,Me_3CCl/AlCl_3}$

(c) Benzene $\xrightarrow[(2)\,HNO_3/H_2SO_4]{(1)\,CH_3-CH(CH_3)-CH_2-Cl/AlCl_3}$

(d) Benzene $\xrightarrow[(2)\,CH_3-CH(CH_3)-CH_2-Cl/AlCl_3]{(1)\,HNO_3/H_2SO_4}$

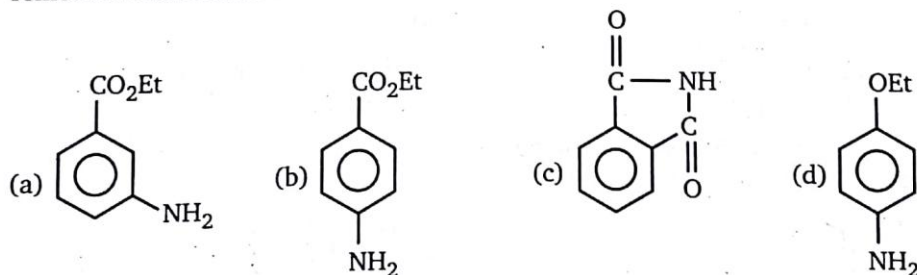
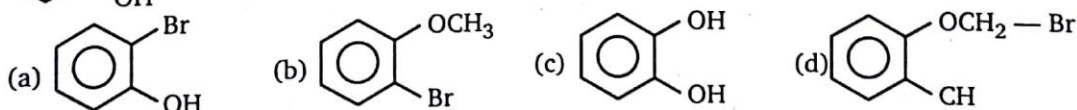
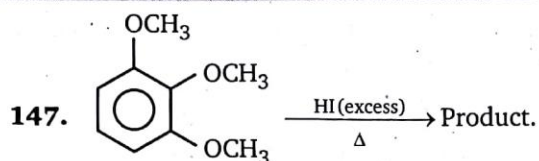
145. Toluene (CH_3) $\xrightarrow[H_2SO_4]{HNO_3}$ (A) (Para isomer) $\xrightarrow[Pd,\,C]{H_2}$ (B) $\xrightarrow{KMnO_4}$ (C) $\xrightarrow[H^+]{EtOH}$ (D) Benzocaine

Benzocaine has been used as a component of appetite suppressants, burn and sunburn remedies. Benzocaine is :

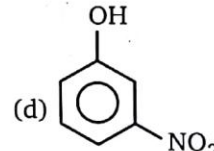
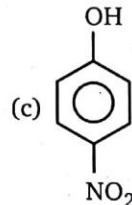
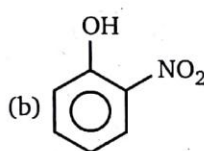
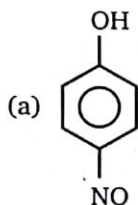
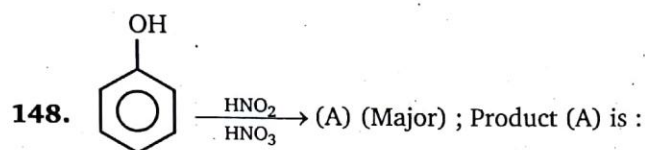
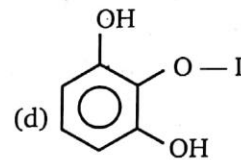
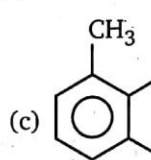
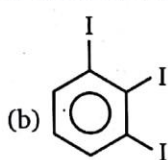
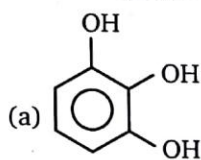
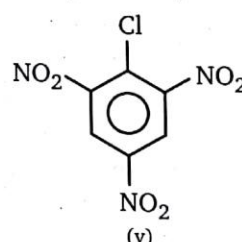
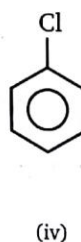
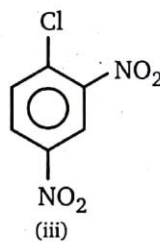
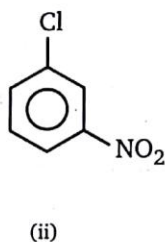
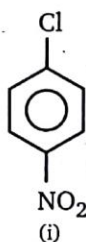
(a) benzene ring with CO_2Et and NH_2 (meta) (b) benzene ring with CO_2Et and NH_2 (para) (c) benzene ring fused with C(=O)–NH–C(=O) (d) benzene ring with OEt and NH_2 (para)

146. benzene ring with $O-CH_3$ and OH (ortho) $\xrightarrow[\Delta]{HBr}$ (A) ; Product (A) of this reaction is :
86%

(a) benzene ring with Br and OH (ortho) (b) benzene ring with OCH_3 and Br (ortho) (c) benzene ring with OH and OH (ortho) (d) benzene ring with OCH_2-Br and CH (ortho)

147. (Benzene ring with three adjacent OCH_3 groups) $\xrightarrow[\Delta]{HI\,(excess)}$ Product.

Predict major product of the above reaction is :

(a) OH, OH, OH (b) I, I, I (c) CH_3 (d) OH, O — I, OH

148. (Phenol, OH) $\xrightarrow[HNO_3]{HNO_2}$ (A) (Major) ; Product (A) is :

149. Arrange in their decreasing order of rate in SNAr.

(a) i > ii > iv > iii > v
(b) ii > i > iii > v > iv
(c) v > iii > i > ii > iv
(d) v > iii > ii > i > iv

150. Which one of the following compounds undergoes bromination of its aromatic ring (electrophilic aromatic substitution) at the fastest rate ?

(a) (tetralin)
(b) N—H
(c) NH
(d) NH, O

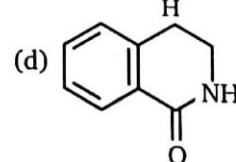
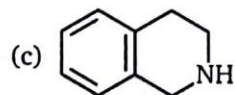
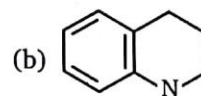
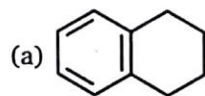
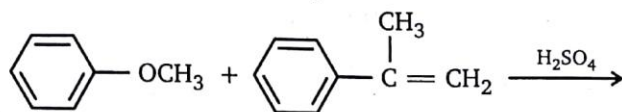
151. What is the product of the following reaction ?

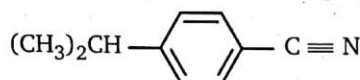
$$C_6H_5-OCH_3 + C_6H_5-\overset{\overset{\large CH_3}{|}}{C}=CH_2 \xrightarrow{H_2SO_4}$$

(a) $C_6H_5-\overset{\overset{\large CH_3}{|}}{C}HCH_2-C_6H_4-OCH_3$ (para)

(b) $(CH_3)_2CH-C_6H_3(OCH_3)-C_6H_5$ (OCH_3 ortho to the phenyl)

(c) $C_6H_5-\overset{\overset{\large CH_3}{|}}{C}HCH_2-C_6H_4-OCH_3$ (ortho)

(d) $(CH_3)_2CH-C_6H_4-C_6H_4-OCH_3$

152. Which sequence represents the best synthesis of 4-isopropylbenzonitrile ?

$$(CH_3)_2CH-C_6H_4-C\equiv N$$

4-Isopropylbenzonitrile

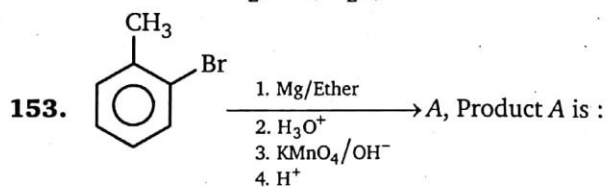
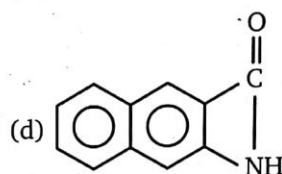
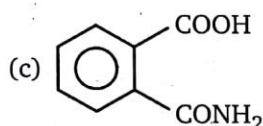
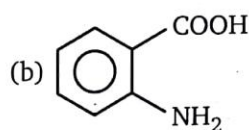
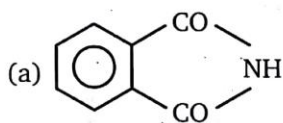
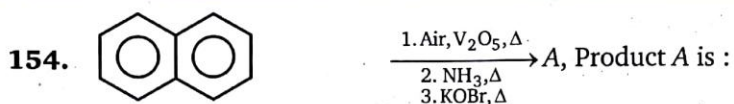
(a) **1.** Benzene + $(CH_3)_2CHCl, AlCl_3$; **2.** $Br_2, FeBr_3$; **3.** KCN

(b) **1.** Benzene + $(CH_3)_2CHCl, AlCl_3$; **2.** HNO_3, H_2SO_4; **3.** Fe, HCl,; **4.** NaOH **5.** $NaNO_2$, HCl, H_2O

(c) **1.** Benzene +$(CH_3)_2CHCl, AlCl_3$; **2.** HNO_3, H_2SO_4 ; **3.** Fe, HCl ; **4.** $NaNO_2/HCl$ **5.** KCN

(d) **1.** Benzene + HNO_3, H_2SO_4 ; **2.** $(CH_3)_2CHCl, AlCl_3$; **3.** Fe, HCl; **4.** $NaNO_2, HCl, H_2O$; **5.** CuCN

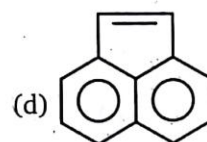
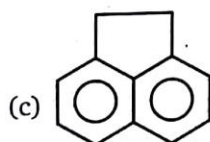
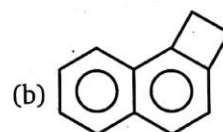
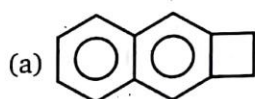
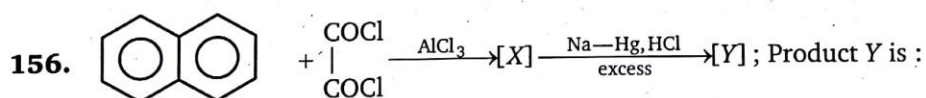
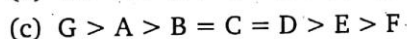
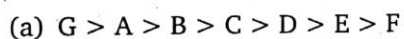
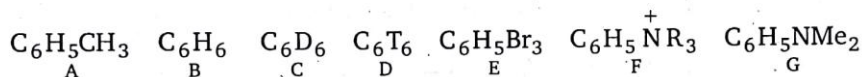
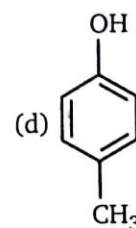
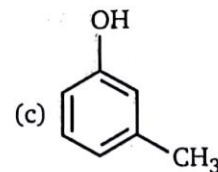
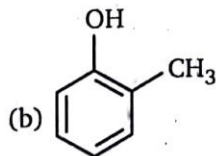
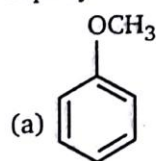
153. o-$CH_3-C_6H_4-Br$ $\xrightarrow[\text{2. } H_3O^+ \text{ 3. } KMnO_4/OH^- \text{ 4. } H^+]{\text{1. Mg/Ether}}$ A, Product A is :

154.

155. What is correct order of rate of nitration of the following compounds ?

$C_6H_5CH_3$ (A) C_6H_6 (B) C_6D_6 (C) C_6T_6 (D) $C_6H_5Br_3$ (E) $C_6H_5\overset{+}{N}R_3$ (F) $C_6H_5NMe_2$ (G)

(a) G > A > B > C > D > E > F (b) G > B > C > D > A > F

(c) G > A > B = C = D > E > F (d) G > A > B > C = D > E > F

156. + COCl–COCl $\xrightarrow{AlCl_3}$ [X] $\xrightarrow[\text{excess}]{\text{Na—Hg, HCl}}$ [Y] ; Product Y is :

157. Compound A (C_7H_8O) is insoluble in water, dilute HCl & aqueous $NaHCO_3$, but it dissolves in dilute NaOH. When A is treated with Br_2 water it is converted into a compound $C_7H_5OBr_3$ rapidly. The structure of A is :

(a) OCH_3 (b) OH, CH_3 (c) OH, CH_3 (d) OH, CH_3

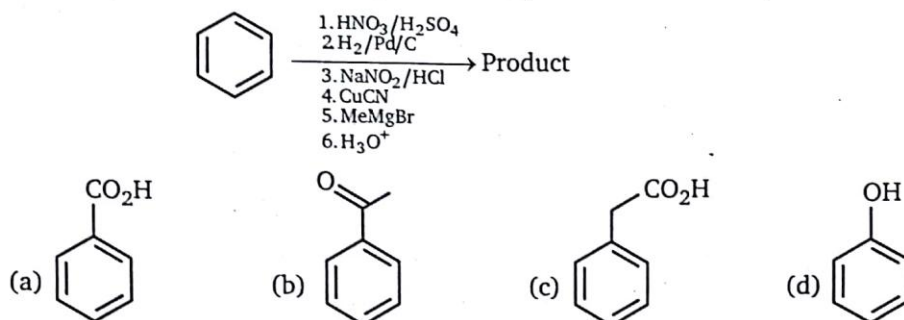
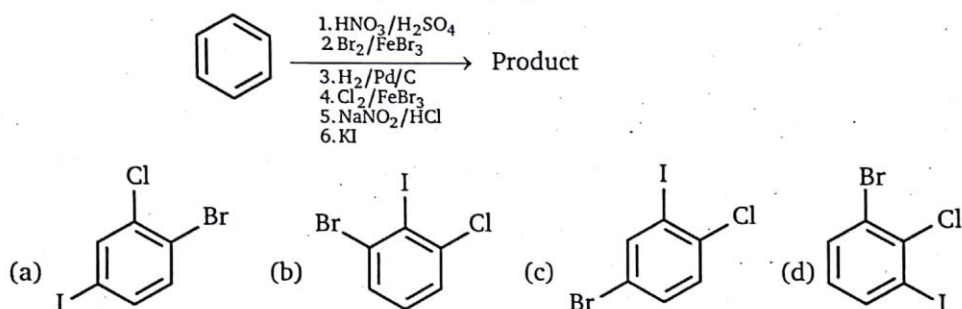
158. Give the product of the following reaction sequence :

Benzene $\xrightarrow[\substack{3.\ NaNO_2/HCl \\ 4.\ CuCN \\ 5.\ MeMgBr \\ 6.\ H_3O^+}]{\substack{1.\ HNO_3/H_2SO_4 \\ 2.\ H_2/Pd/C}}$ Product

(a) CO_2H (b) O (c) CO_2H (d) OH

159. Give the product of the following reaction sequence:

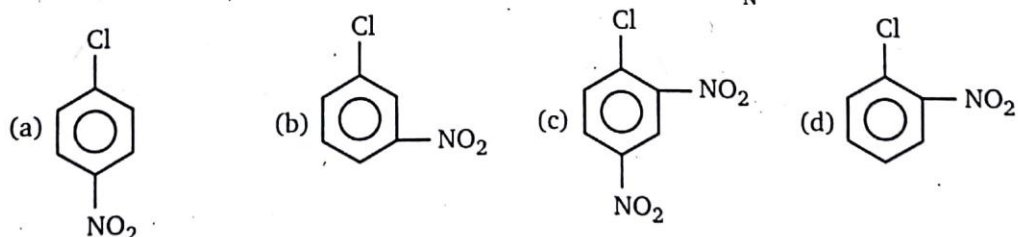
Benzene $\xrightarrow[\substack{3.\ H_2/Pd/C \\ 4.\ Cl_2/FeBr_3 \\ 5.\ NaNO_2/HCl \\ 6.\ KI}]{\substack{1.\ HNO_3/H_2SO_4 \\ 2.\ Br_2/FeBr_3}}$ Product

(a) Cl, Br, I (b) I, Br, Cl (c) I, Cl, Br (d) Br, Cl, I

160. Which represents an intermediate formed in the reaction of toluene and chlorine at elevated temperature in sunlight ?

161. The decreasing order of reactivity of *m*-nitrobromobenzene (I), 2, 4, 6- trinitrobromo-benzene (II), *p*-nitrobromobenzene (III), and 2,4-dinitrobromobenzene (IV), towards OH^- ions is :

(a) I > II > III > IV (b) II > IV > III > I

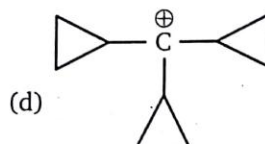
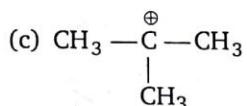
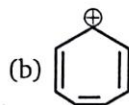
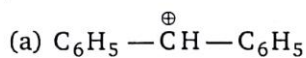
(c) IV > II > III > I (d) II > IV > I > III

162. Which one of the following compounds is most reactive for $ArS_{N}2$ reaction ?

163. Which one amongst the following carbocations is most stable ?

(a) $C_6H_5-\overset{\oplus}{C}H-C_6H_5$

(b) [cyclohexadienyl cation, ⊕]

(c) $CH_3-\overset{\oplus}{C}(CH_3)-CH_3$

(d)

164. Cyclopentadiene is much more acidic than cyclopentane. The reason is that :

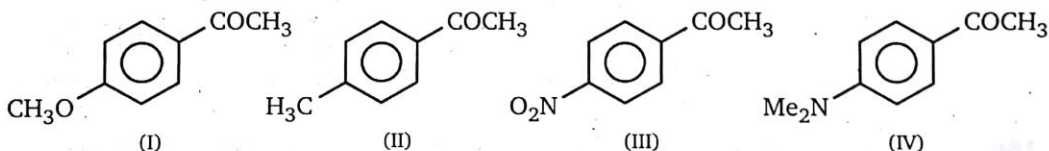
(a) cyclopentadiene has conjugated double bonds

(b) cyclopentadiene has both sp^2 and sp^3 hybridized carbon atoms

(c) cyclopentadiene is a strain-free cyclic system

(d) cyclopentadienide ion, the conjugate base of cyclopentadiene, is an aromatic species and hence has higher stability

165.

(I) CH_3O–C_6H_4–$COCH_3$ (II) H_3C–C_6H_4–$COCH_3$ (III) O_2N–C_6H_4–$COCH_3$ (IV) Me_2N–C_6H_4–$COCH_3$

Friedel-Crafts acylation reaction can be used to obtain the compounds

(a) II, III and IV (b) I, III and IV

(c) I and II (d) II and III

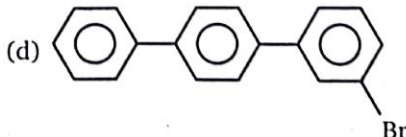
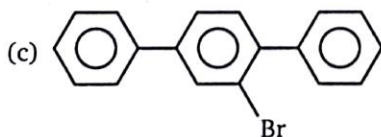
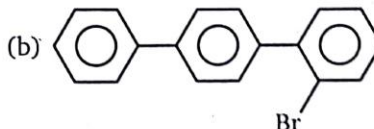
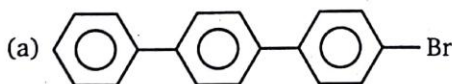
166. The major product of the reaction is :

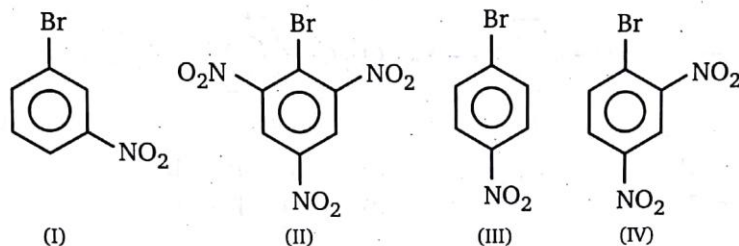
$C_6H_5-C_6H_4-C_6H_5 \xrightarrow[FeBr_3]{Br_2}$ Product

(a) $C_6H_5-C_6H_4-C_6H_4-Br$

(b)

(c) [terphenyl with Br on the central ring]
Br

(d)

167. The decreasing order of reactivity of given compound towards nucleophilic substitution with aqueous NaOH is :

(I) 1-Bromo-3-nitrobenzene: Br, NO_2 (meta)
(II) Br, O_2N, NO_2, NO_2 (2,4,6-trinitro)
(III) Br, NO_2 (para)
(IV) Br, NO_2 (ortho), NO_2 (para)

(a) I > II > III > IV
(b) II > IV > III > I
(c) IV > II > III > I
(d) II > IV > I > III

168. Identify the end product (*B*) of the following sequence of reactions.

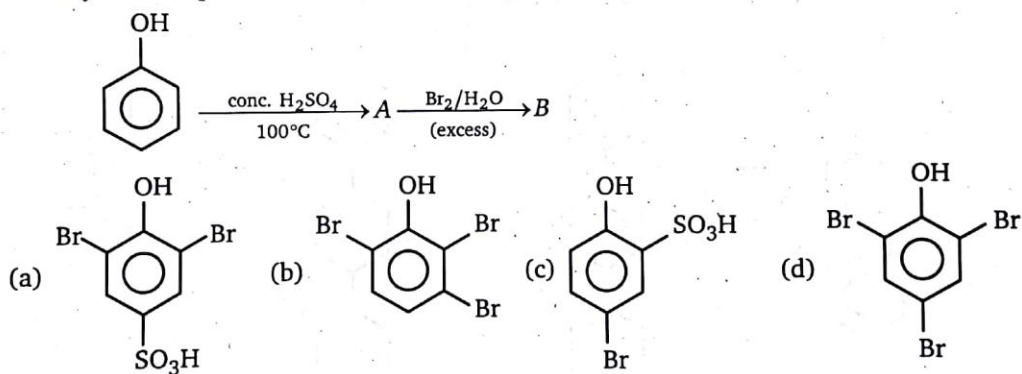
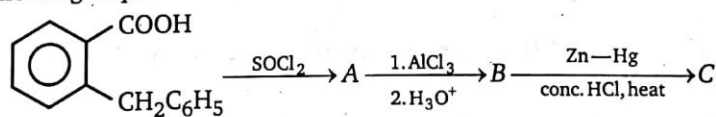
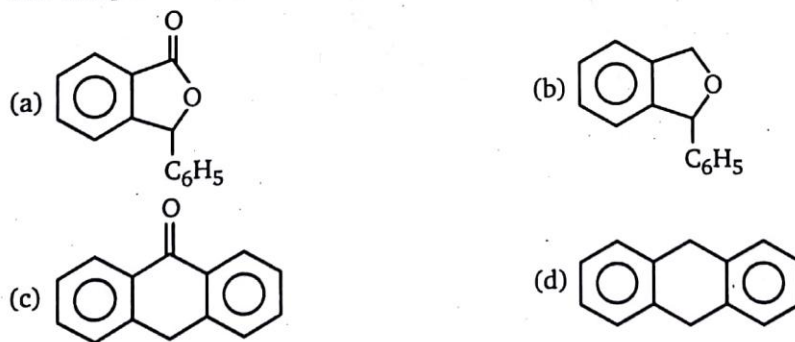
$$\text{C}_6\text{H}_5\text{OH} \xrightarrow[100°\text{C}]{\text{conc. } H_2SO_4} A \xrightarrow[\text{(excess)}]{Br_2/H_2O} B$$

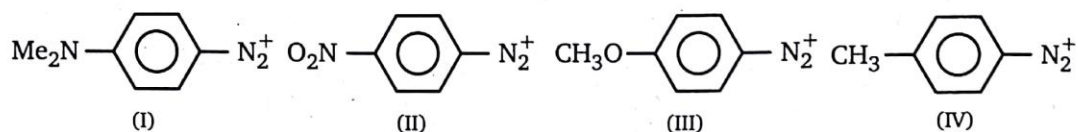
(a) OH, Br, Br, SO_3H (2,6-dibromo-4-sulphonic acid phenol)
(b) OH, Br, Br, Br (2,3,6-tribromophenol)
(c) OH, SO_3H, Br (2-sulphonic acid-4-bromophenol)
(d) OH, Br, Br, Br (2,4,6-tribromophenol)

169. Consider the following sequence of reactions :

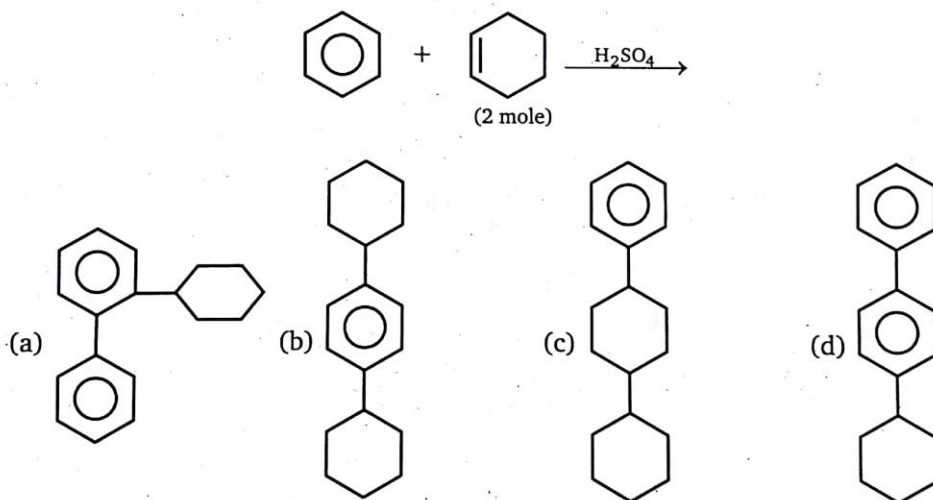
$$\text{C}_6\text{H}_4(\text{COOH})(\text{CH}_2\text{C}_6\text{H}_5) \xrightarrow{SOCl_2} A \xrightarrow[2.\ H_3O^+]{1.\ AlCl_3} B \xrightarrow[\text{conc. HCl, heat}]{\text{Zn—Hg}} C$$

The end product (*C*) is :

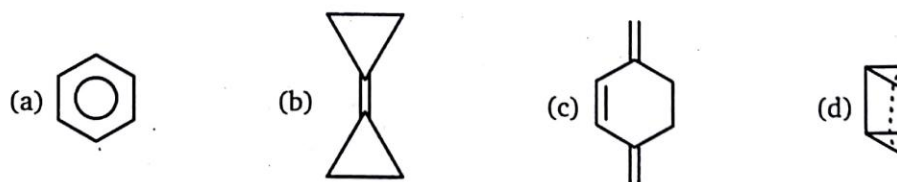
(a) O, O, C_6H_5 (3-phenylphthalide)
(b) O, C_6H_5 (1-phenyl-1,3-dihydroisobenzofuran)
(c) O (anthrone)
(d) (9,10-dihydroanthracene)

170. For the diazonium ions the order of reactivity towards diazo-coupling with phenol in the presence of dilute NaOH is :

$Me_2N-C_6H_4-N_2^+$ (I) $O_2N-C_6H_4-N_2^+$ (II) $CH_3O-C_6H_4-N_2^+$ (III) $CH_3-C_6H_4-N_2^+$ (IV)

(a) I < IV < II < III (b) I < III < IV < II
(c) III < I < II < IV (d) III < I < IV < II

171. Major product obtained in given reaction is :

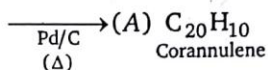
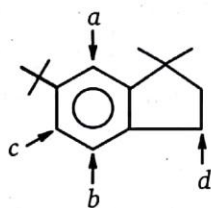
C_6H_6 + cyclohexene (2 mole) $\xrightarrow{H_2SO_4}$

(a) (b)
(c)
(d)
172. (A) $\xrightarrow[\text{or } AlCl_3]{H^{\oplus}}$ (B) (major) ; (A) & (B) are isomers. Product (B) is :

Dewar's Benzene

(a)
(b)
(c)
(d)

173. The step shown below is a recent synthesis of corannulene.

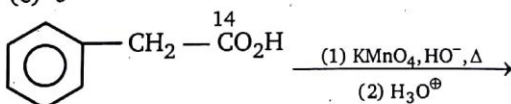
Product (A) is :

174.

a, b, c, d

Identify the position where E.A.S. will take place :

(a) a (b) b

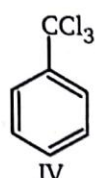
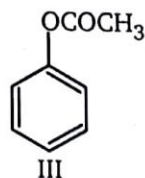
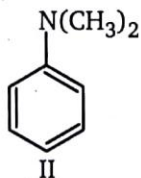
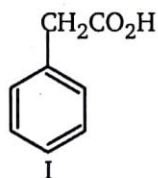
(c) c (d) all the position are identical

175. $C_6H_5-CH_2-\overset{14}{C}O_2H \xrightarrow[(2)\ H_3O^{\oplus}]{(1)\ KMnO_4,\ HO^-,\ \Delta}$

The labelled carbon goes with :

(a) $Ph-\overset{14}{C}O_2H$ (b) $\overset{14}{C}O_2$ (c) $Ph-\overset{14}{C}H_2-CO_2H$ (d) $\overset{14}{C}H_4$

176. What is the expected order of reactivity of the following compounds in electrophilic chlorination ($Cl_2 + FeCl_3$) ?

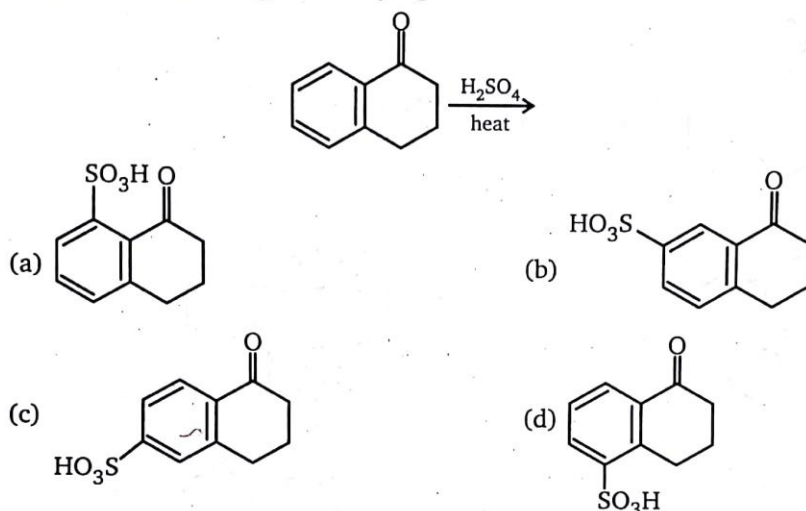
(more reactive > less reactive)

I: $C_6H_5CH_2CO_2H$ II: $C_6H_5N(CH_3)_2$ III: $C_6H_5OCOCH_3$ IV: $C_6H_5CCl_3$

(a) I > II > III > IV (b) IV > III > II > I (c) III > I > IV > II (d) II > III > I > IV

177. Which of the following is the major product from sulfonation of α-tetralone ?

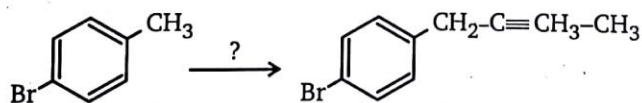
$\xrightarrow[\text{heat}]{H_2SO_4}$

(a) (b) HO$_3$S

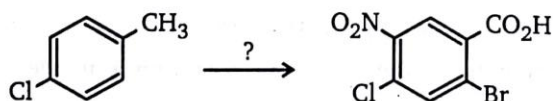
(c) HO$_3$S (d) SO$_3$H

178. Which of the following procedures would be best for the preparation of phenyl benzyl ether ? $C_6H_5OCH_2C_6H_5$

(a) $C_6H_5Cl + C_6H_5CH_2O^{(-)}Na^{(+)}$
(b) $C_6H_5O^{(-)}Na^{(+)} + C_6H_5CH_2Cl$
(c) $2C_6H_5Cl + Na_2O$
(d) $2C_6H_5MgBr + CH_2O$

179. Which of the following procedures would be best for achieving the following reaction ?

CH_3 Br $\xrightarrow{?}$ $CH_2\text{-}C{\equiv}CH_3\text{-}CH_3$ Br

(a) (i) KOH and heat (ii) $CH_3C \equiv C — Br$
(b) (i) $KMnO_4$ and heat (ii) $CH_3C \equiv C^{(-)}Na^{(+)}$ (iii) excess H_2O
(c) (i) NBS in CCl_4 and heat (ii) $CH_3C \equiv C^{(-)}Na^{(+)}$
(d) (i) Mg in ether (ii) $CH_3C \equiv CBr$ (iii) excess H_3PO_4

180. Which of the following procedures would be best for achieving the following reaction ?

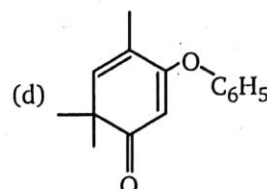
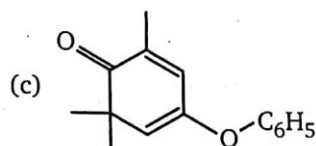
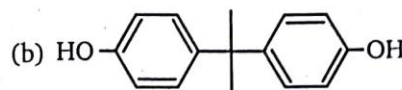
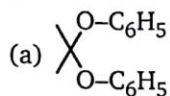
CH_3 Cl $\xrightarrow{?}$ O_2N CO_2H Cl Br

(a) (i) $Br_2 + FeBr_3$ (ii) $KMnO_4$ and heat (iii) HNO_3 and H_2SO_4
(b) (i) $KMnO_4$ and heat (ii) $Br_2 + FeBr_3$ (iii) HNO_3 and H_2SO_4
(c) (i) NBS in CCl_4 and heat (ii) $KMnO_4$ and heat (iii) HNO_3 and H_2SO_4
(d) (i) NBS in CCl_4 and heat (ii) $NaNO_2$ and heat

181. Phenol reacts with acetone in the presence of conc. sulphuric acid to form a $C_{15}H_{16}O_2$ product. Which of the following compounds is this product ?

(a) $(CH_3)_2C(O{-}C_6H_5)_2$

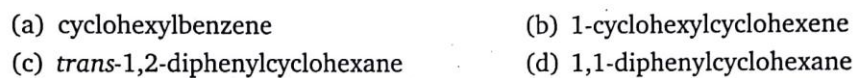
(b) HO–C_6H_4–$C(CH_3)_2$–C_6H_4–OH

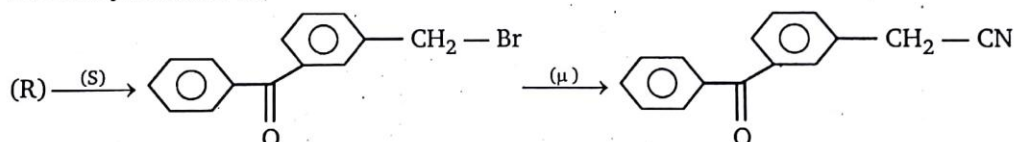
(c) O, $O{-}C_6H_5$

(d) O, $O{-}C_6H_5$

182. Heating benzene in a large excess of 80% D_2SO_4 in D_2O results in what product ?

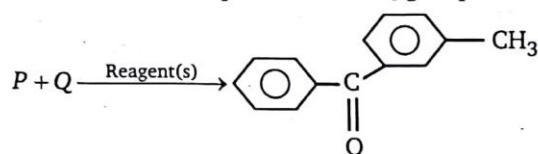
(a) $C_6H_5SO_3D$ (b) C_6H_5OD (c) C_6H_5D (d) C_6D_6

183. A solution of cyclohexene in benzene is stirred at 0°C while concentrated sulphuric acid is added. After washing away the acid and removing the excess benzene, what product is isolated?

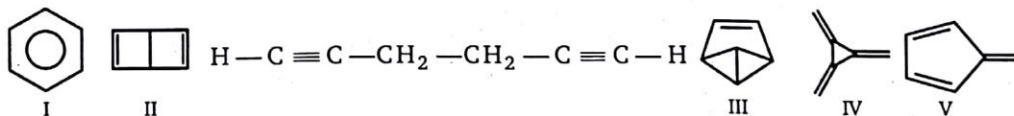
(a) cyclohexylbenzene
(b) 1-cyclohexylcyclohexene
(c) *trans*-1,2-diphenylcyclohexane
(d) 1,1-diphenylcyclohexane

184. Indentify the reagents S and μ in the scheme below in which R is converted to the nitrite V via the benzylic halide T.

R, S and μ respectively are :

	R	S	μ
(a)	C_6H_5–Cl	H–C(=O)–C_6H_4–CH_2Br ($AlCl_3$)	HCN
(b)		Cl–C(=O)–C_6H_4–CH_2Br ($AlCl_3$)	HCN
(c)		Cl–C(=O)–C_6H_4–CH_2Br ($AlCl_3$)	KCN
(d)	C_6H_5–C(=O)–Cl	C_6H_5–CH_2Br ($AlCl_3$)	KCN

185. Two aromatic compounds *P* and *Q* give product *R*.

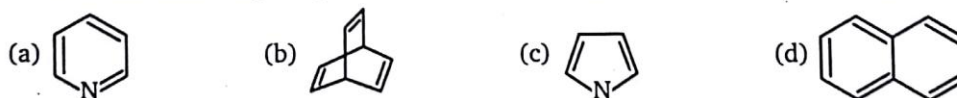
$$P + Q \xrightarrow{\text{Reagent(s)}} C_6H_5-\underset{\underset{O}{\|}}{C}-C_6H_4-CH_3$$

Reactant *P*, *Q* and reagent used in above reaction are :

	P	Q	Reagent
(a)	$C_6H_5-\underset{\underset{O}{\|}}{C}-Cl$	$C_6H_5-CH_3$	$AlCl_3$
(b)	$C_6H_5-\underset{\underset{O}{\|}}{C}-H$	$Cl-C_6H_4-CH_3$	$AlCl_3$
(c)	C_6H_6	$CH_3-C_6H_4-C(=O)-Cl$	$AlCl_3$
(d)	C_6H_6	$Cl-\overset{\overset{O}{\|}}{C}-C_6H_4-CH_3$	$ZnCl_2$

186. Which of the following C_6H_6 compounds has a single set of structurally equivalent hydrogen atoms ?

(a) I and II (b) I and IV (c) I and V (d) I, II and III

187. Which of the following compounds would not be considered aromatic in its behaviour?

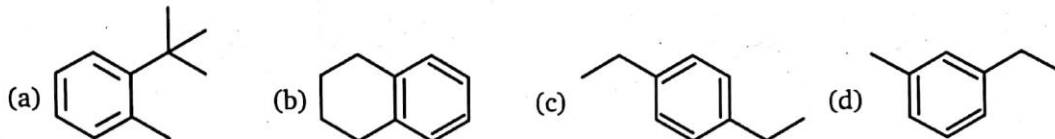
(a)

(b) (c) (d)

188. A C_8H_{10} hydrocarbon is nitrated by HNO_3 and sulphuric acid. Two, and only two, $C_8H_9NO_2$ isomers are obtained. Which of the following fits this evidence ?

(a) ethyl benzene (b) *ortho*-xylene (c) *meta*-xylene (d) *para*-xylene

189. Which of the following benzene ring substituents is deactivating but *ortho-para* directing ?

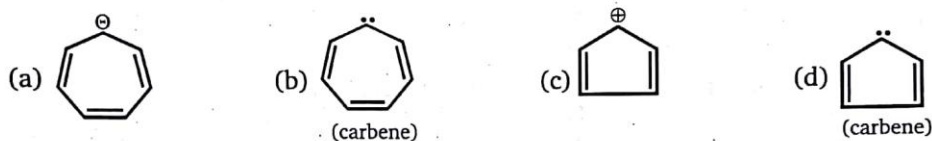
(a) $-N=O$ (b) $-OCH_3$ (c) $-COCH_3$ (d) $-NO_2$

190. Which of the following compounds forms *ortho*- benzenedicarboxylic acid when oxidized by hot aqueous potassium permanganate ?

191. Which of the following organic chlorides will not give a Friedel-Craft alkylation product when heated with benzene and $AlCl_3$?

(a) $(CH_3)_3CCl$ (b) $CH_2=CHCH_2Cl$ (c) CH_3CH_2Cl (d) $CH_2=CHCl$

192. Which of the following is aromatic ?

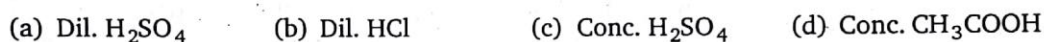
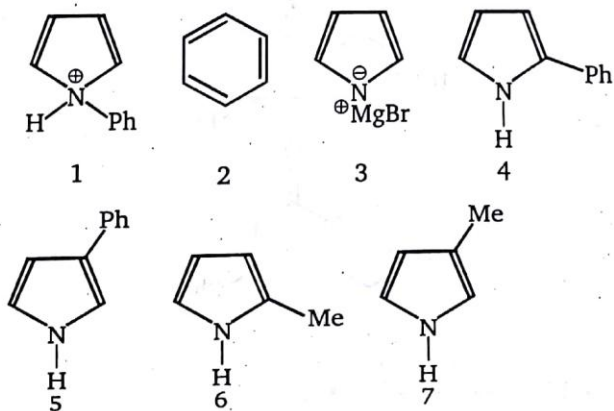
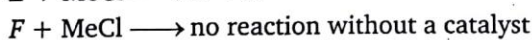
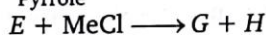
(a) (b) (c) (d)

(b) (carbene) (d) (carbene)

193. Which of the following substance will increase the acidity of phenol ?

(a) Dil. H_2SO_4 (b) Dil. HCl (c) Conc. H_2SO_4 (d) Conc. CH_3COOH

194. Pyrrole + PhMgBr $\longrightarrow E + F$

E + MeCl $\longrightarrow G + H$

F + MeCl $\longrightarrow$ no reaction without a catalyst

The structure of products $E-H$, respectively are

(a) 3, 2, 6, 7 (b) 4, 5, 6, 1 (c) 3, 4, 5, 2 (d) 3, 2, 4, 5

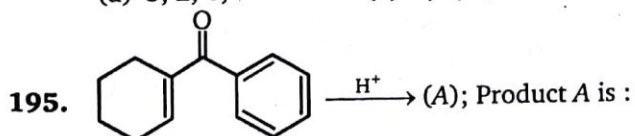
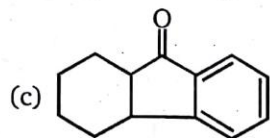
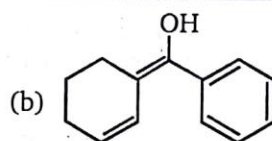
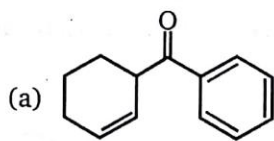
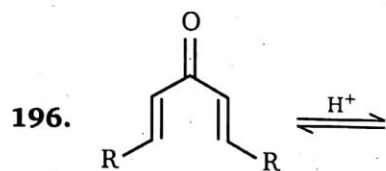
195. (cyclohexenyl phenyl ketone) $\xrightarrow{H^+}$ (A); Product A is :

(a) O

(b) OH

(c) O

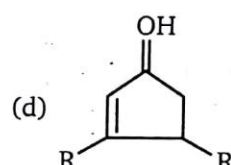
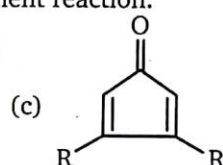
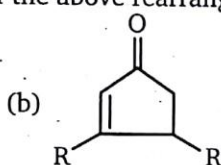
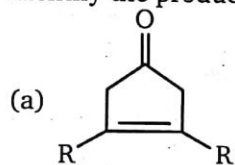
(d) none of these

196. $\underset{}{\overset{H^+}{\rightleftharpoons}}$

Identify the product of the above rearrangement reaction.

(a)

(b)

(c)

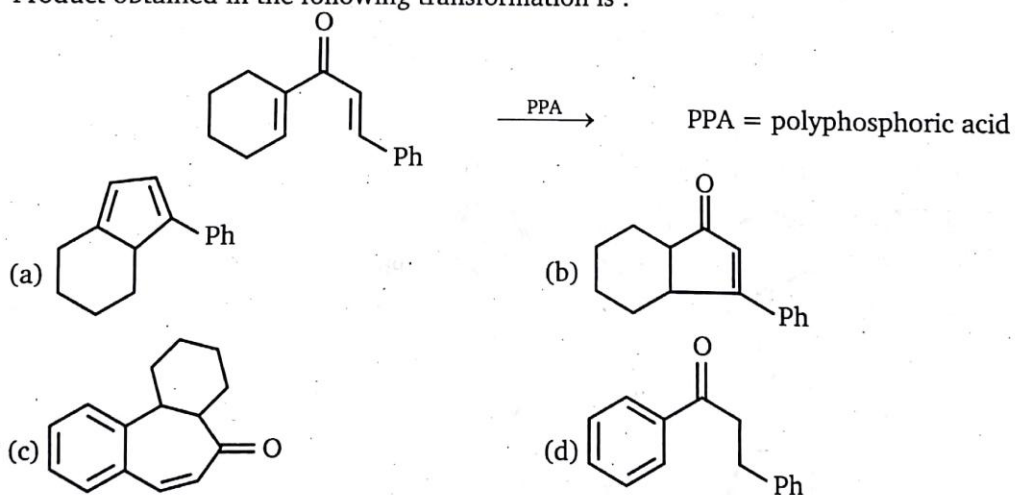
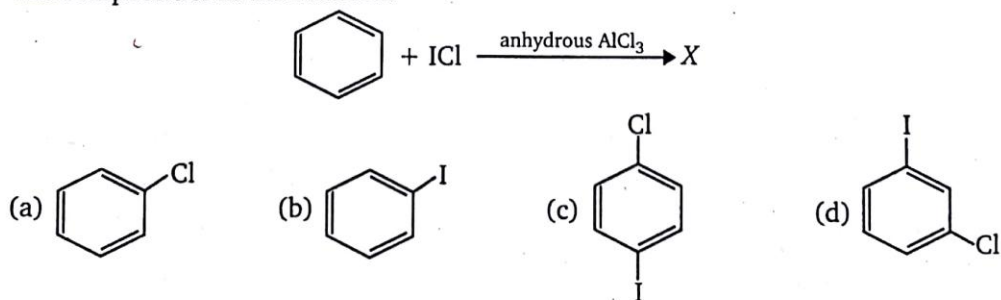
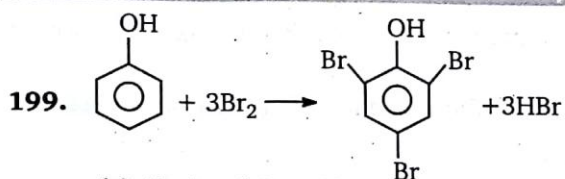
(d)

197. Product obtained in the following transformation is :

O, Ph $\xrightarrow{PPA}$ PPA = polyphosphoric acid

(a) Ph

(b) O, Ph

(c) O

(d) O, Ph

198. The compound X in the reaction.

+ ICl $\xrightarrow{\text{anhydrous } AlCl_3}$ X

(a)

(b)

(c)

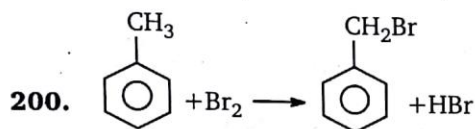
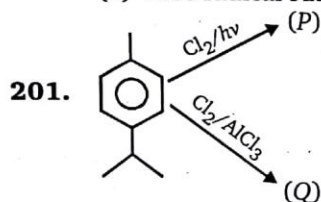
(d) I, Cl

199. Phenol $+ 3Br_2 \longrightarrow$ 2,4,6-tribromophenol $+ 3HBr$

(a) Nucleophilic addition
(b) Nucleophilic substitution
(c) Electrophilic addition
(d) Electrophilic substitution
(e) Free radical substitution

200. Toluene (CH_3) $+ Br_2 \longrightarrow$ Benzyl bromide (CH_2Br) $+ HBr$

(a) Nucleophilic addition
(b) Nucleophilic substitution
(c) Electrophilic addition
(d) Electrophilic substitution
(e) Free radical substitution

201. p-Isopropyltoluene $\xrightarrow{Cl_2/h\nu}$ (P); $\xrightarrow{Cl_2/AlCl_3}$ (Q)

Identify major product of both respectively.

(a) $CH_2—Cl$ (benzylic chlorination of methyl), Cl on ring ortho to methyl
(b) Cl on tertiary carbon of isopropyl group, Cl on ring ortho to isopropyl group
(c) Cl on tertiary carbon of isopropyl group, Cl on ring ortho to methyl
(d) Cl on tertiary carbon of isopropyl group, Cl on ring ortho to methyl and Cl on tertiary carbon of isopropyl group

202. Phenol $+ Ph—N_2^+Cl^- \xrightarrow{pH=10\text{-}11}$ p-hydroxyazobenzene ($N{=}N—Ph$ para to OH)

Characteristics of above reaction is :

(a) C — N coupling reaction ; Carbocation is intermediate
(b) N — N coupling reaction ; Carbocation is intermediate
(c) C — N coupling reaction ; Carbanion is intermediate
(d) N — N coupling reaction ; Carbanion is intermediate

203. The compound formed on heating chlorobenzene with chloral in the presence of concentrated sulphuric acid, is :

(a) Freon (b) DDT (c) Gammexene (d) Hexachloroethane

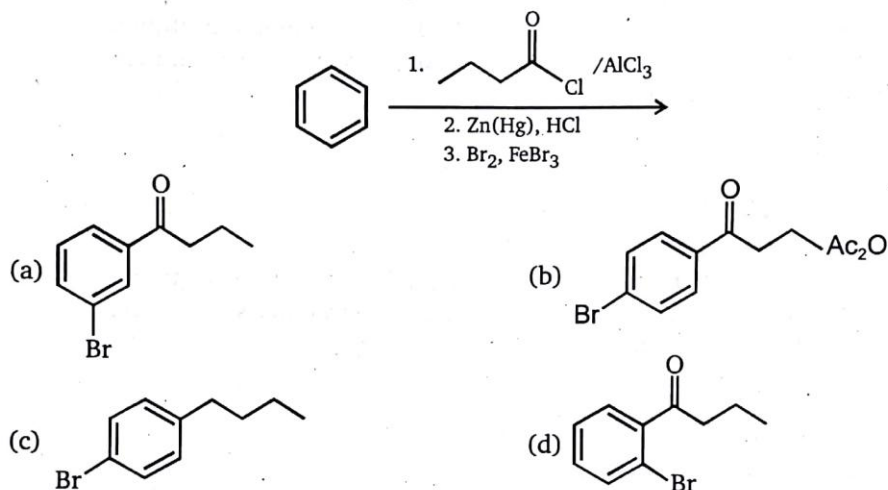
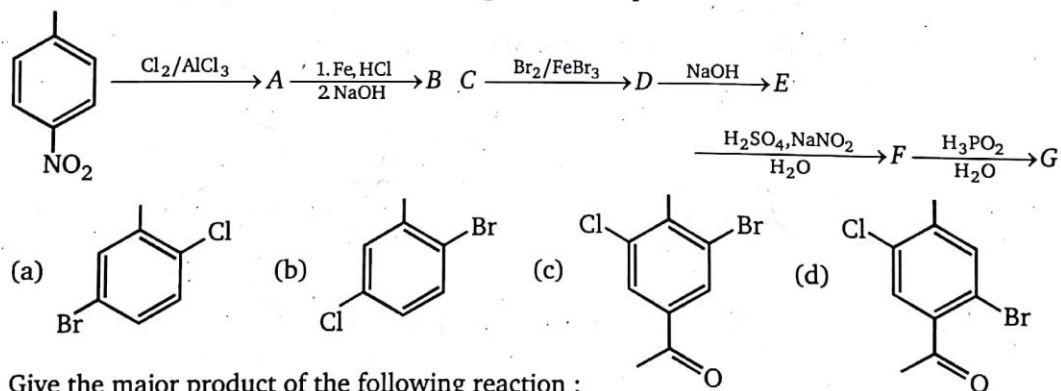
204. Predict the product of the following reaction.

Benzene → 1. $CH_3CH_2CH_2COCl$ / $AlCl_3$; 2. Zn(Hg), HCl; 3. Br_2, $FeBr_3$

(a) Br (b) Br, Ac_2O (c) Br (d) Br

205. Predict the major product of the following reaction sequence.

NO_2 → $Cl_2/AlCl_3$ → A → 1. Fe, HCl; 2. NaOH → B C → $Br_2/FeBr_3$ → D → NaOH → E → H_2SO_4, $NaNO_2$ / H_2O → F → H_3PO_2 / H_2O → G

(a) Cl, Br (b) Br, Cl (c) Cl, Br, O (d) Cl, Br, O

206. Give the major product of the following reaction :

O, NHPh → CH_3Cl, $AlCl_3$ →

(a) O, NHPh, H_3C (b) O, NHPh, CH_3

(c) H_3C–C_6H_4–NHCOPh (para)

(d) CH_3–C_6H_4–NHCOPh (meta)

207. p-Nitrotoluene (CH_3, NO_2 on benzene) $\xrightarrow[Fe]{Br_2}$ (A) $\xrightarrow{Sn/HCl}$ (B) $\xrightarrow{NaNO_2 + HCl}$ (C) $\xrightarrow{H_3PO_2}$ (D) $\xrightarrow[HO^{\ominus}]{KMnO_4}$ (E)

Product (E) is :

(a) 4-bromobenzoic acid (CO_2H, Br para)
(b) 3-bromobenzoic acid (CO_2H, Br meta)
(c) 2-bromobenzoic acid (CO_2H, Br ortho)
(d) benzene-1,4-dicarboxylic acid (CO_2H, CO_2H para)

208. 1-Fluoro-2,4-dinitrobenzene (F, NO_2, NO_2) $\xrightarrow{NH_2–NH_2}$ A $\xrightarrow[H^+, \Delta]{\text{butan-2-one}}$ B ; Products;

Incorrect statements regarding above reaction is

(a) Product *A* is 2, 4-DNP
(b) *A* to *B* dehydration reaction
(c) *A* to *B*, geometrical isomersm will obtained as a product
(d) B is known as oxime

209. (i) chlorobenzene is mono-nitrated to M
(ii) nitrobenezene is mono-chlorinated to N
(iii) anisole is mono-nitrated to P
(iv) 2-nitrochlorobenzene is mono-nitrated to Q.

Out of M, N, P and Q the compound that undergoes reaction with aq. NaOH fastest is

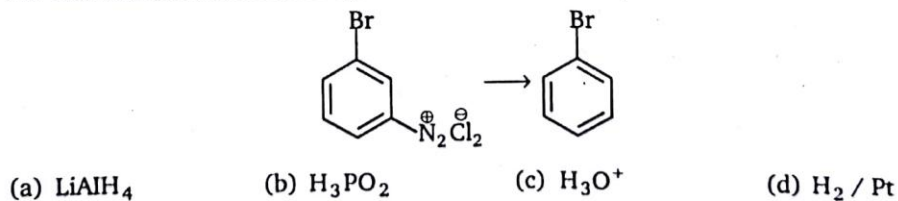
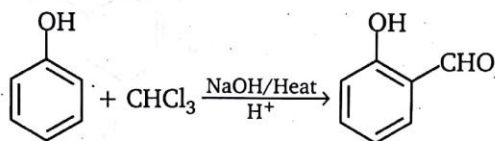
(a) M (b) N (c) P (d) Q

210. For the transformation the reagent used is

3-Bromobenzenediazonium chloride (Br, $\overset{\oplus}{N_2}\overset{\ominus}{Cl}$) $\longrightarrow$ Bromobenzene (Br)

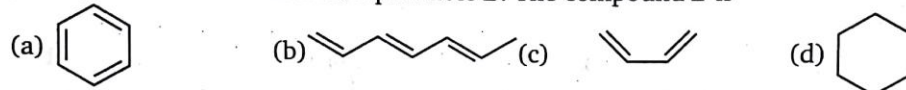
(a) $LiAlH_4$ (b) H_3PO_2 (c) H_3O^+ (d) H_2 / Pt

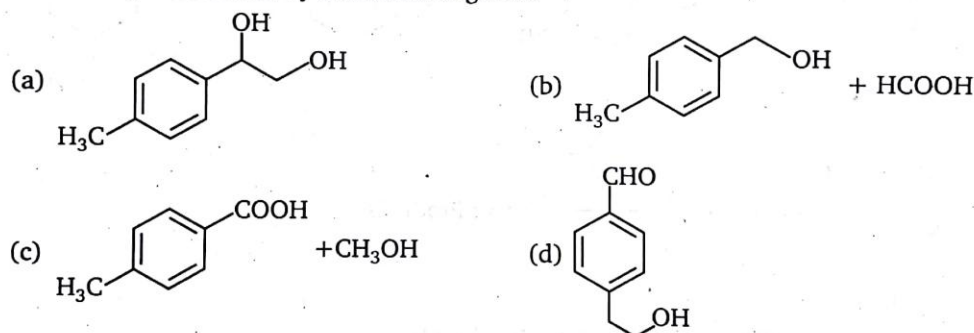
211. The reaction

OH + $CHCl_3$ $\xrightarrow[H^+]{NaOH/Heat}$ OH, CHO

is known as

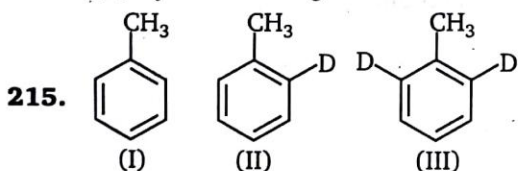
(a) Perkin reaction
(b) Sandmeyer reaction
(c) Reimer-Tiemann reaction
(d) Cannizzaro reaction

212. A compound X formed after heating coke with lime react with water to give Y which on passing over redhot iron at 873 produces Z. The compound Z is

(a) (b) (c) (d)

213. The reaction of 50% aq KOH on an equimolar mixture of 4-methylbenzaldehyde and formaldehyde followed by acidification gives :

(a) OH, OH, H_3C
(b) OH, H_3C + HCOOH
(c) COOH, H_3C + CH_3OH
(d) CHO, OH

214. Which isomer of xylene can give three different monochloroderivatives ?

(a) o-xylene
(b) m-xylene
(c) *p*-xylene
(d) xylene cannot give a monochloro derivative

215.

The rate of o-nitration of the above compounds, (I) toluene, (II) 2-D-toluene and (III) 2, 6-D_2-toluene is in the following order

(a) I > II > III
(b) II > I > III
(c) III > I > II
(d) The rate is the same for all the three compounds

216. Cyclooctatetraene is expected to have :

(a) a planar structure
(b) a tub-shaped structure
(c) open chain isomeric structure
(d) tatutomeric bicyclic structure

ANSWERS — LEVEL 1

1.	(b)	2.	(d)	3.	(b)	4.	(c)	5.	(a)	6.	(b)	7.	(c)	8.	(b)
9.	(d)	10.	(d)	11.	(a)	12.	(a)	13.	(a)	14.	(a)	15.	(a)	16.	(b)
17.	(b)	18.	(a)	19.	(b)	20.	(b)	21.	(c)	22.	(c)	23.	(b)	24.	(b)
25.	(d)	26.	(c)	27.	(c)	28.	(b)	29.	(b)	30.	(b)	31.	(b)	32.	(a)
33.	(b)	34.	(d)	35.	(c)	36.	(c)	37.	(a)	38.	(c)	39.	(a)	40.	(b)
41.	(b)	42.	(c)	43.	(c)	44.	(b)	45.	(c)	46.	(b)	47.	(b)	48.	(b)
49.	(b)	50.	(b)	51.	(b)	52.	(a)	53.	(c)	54.	(c)	55.	(a)	56.	(a)
57.	(d)	58.	(b)	59.	(b)	60.	(b)	61.	(c)	62.	(b)	63.	(b)	64.	(b)
65.	(a)	66.	(a)	67.	(c)	68.	(b)	69.	(a)	70.	(d)	71.	(b)	72.	(a)
73.	(a)	74.	(c)	75.	(a)	76.	(d)	77.	(c)	78.	(b)	79.	(c)	80.	(b)
81.	(b)	82.	(c)	83.	(a)	84.	(c)	85.	(d)	86.	(b)	87.	(d)	88.	(b)
89.	(d)	90.	(d)	91.	(d)	92.	(d)	93.	(d)	94.	(b)	95.	(c)	96.	(d)
97.	(b)	98.	(d)	99.	(b)	100.	(b)	101.	(b)	102.	(c)	103.	(d)	104.	(a)
105.	(b)	106.	(d)	107.	(c)	108.	(b)	109.	(b)	110.	(b)	111.	(c)	112.	(b)
113.	(c)	114.	(a)	115.	(b)	116.	(b)	117.	(a)	118.	(b)	119.	(b)	120.	(c)
121.	(b)	122.	(b)	123.	(c)	124.	(b)	125.	(b)	126.	(b)	127.	(c)	128.	(c)
129.	(c)	130.	(b)	131.	(d)	132.	(b)	133.	(b)	134.	(a)	135.	(b)	136.	(a)
137.	(b)	138.	(c)	139.	(d)	140.	(b)	141.	(b)	142.	(c)	143.	(a)	144.	(b)
145.	(b)	146.	(c)	147.	(a)	148.	(c)	149.	(c)	150.	(b)	151.	(d)	152.	(c)
153.	(c)	154.	(b)	155.	(c)	156.	(c)	157.	(c)	158.	(b)	159.	(c)	160.	(c)
161.	(b)	162.	(c)	163.	(d)	164.	(d)	165.	(c)	166.	(c)	167.	(b)	168.	(d)
169.	(d)	170.	(b)	171.	(b)	172.	(a)	173.	(a)	174.	(b)	175.	(b)	176.	(d)
177.	(b)	178.	(b)	179.	(c)	180.	(a)	181.	(b)	182.	(d)	183.	(a)	184.	(c)
185.	(c)	186.	(b)	187.	(b)	188.	(b)	189.	(a)	190.	(b)	191.	(d)	192.	(b)
193.	(c)	194.	(a)	195.	(c)	196.	(b)	197.	(b)	198	(b)	199	(d)	200	(e)
201.	(c)	202.	(c)	203.	(b)	204.	(c)	205.	(a)	206.	(c)	207.	(c)	208.	(d)
209.	(d)	210.	(a)	211.	(c)	212.	(a)	213.	(b)	214	(b)	215.	(d)	216.	(b)

LEVEL-2

1. Each of the six compounds shown at the bottom of the page has two aromatic (benzene) rings. In each case the two rings are different and are labeled A & B. **If an electrophilic substitution, such as nitration or bromination**, is carried out on each compound, then identify which ring (A or B) will be preferentially attacked, and indicate the orientation of the substitution (ortho/para, meta or all sites).

Compound	Reactivity		Substitution		Compound	Reactivity		Substitution	
	A		ortho/para			**A**		ortho/para	
1.	**B**		meta		**2.**	**B**		meta	
			all sites					all sites	
	A		ortho/para			**A**		ortho/para	
3.	**B**		meta		**4.**	**B**		meta	
			all sites					all sites	
	A		ortho/para			**A**		ortho/para	
5.	**B**		meta		**6.**	**B**		meta	
			all sites					all sites	

	Compound		Compound
1.	A, O, B	**2.**	CH_3, N, S, O, O, A, B
3.	A, O, O, B	**4.**	CH_3, N, O, A, B, N, O, CH_3
5.	A, O, CH_3, N, O, B	**6.**	O, CH_3, CH_3, A, B

2. When given substituents on a benzene ring, as activating or de-activating and as ortho-para or meta directing for elctrophilic aromatic substitution fill the following by appropriate (✓) right or (✗) wrong.

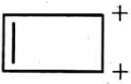
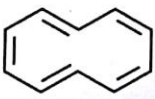
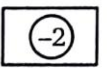
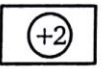
	Substituent	Activating	De-activating	Ortho/para	Meta
1.	$-OCH_3$				
2.	$-C(=O)-O-CH_3$				
3.	$-O-C(=O)-CH_3$				
4.	$-CH_3$				
5.	$-F$				
6.	$-Ph$				
7.	$-NH-C(=O)-CH_3$				
8.	$-C(=O)-NH-CH_3$				
9.	$-Br$				
10.	$-CN$				
11.	$-CF_3$				
12.	$-C(=O)-NH_2$				
13.	$-C(=O)-OH$				
14.	$-CH=CH_2$				

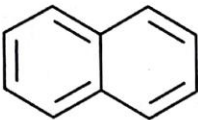
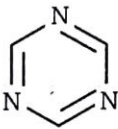
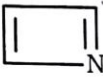
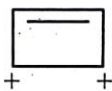
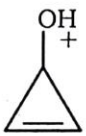
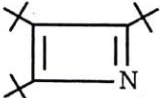
15.	$-CH=CH-\overset{O}{\overset{\|\|}{C}}-OH$				
16.	$-CH=CH-\overset{O}{\overset{\|\|}{C}}-H$				
17.	$-S-Et$				
18.	$-\underset{O}{\underset{\|\|}{S}}-Et$				
19.	$-\overset{O}{\overset{\|\|}{\underset{O}{\underset{\|\|}{S}}}}-Et$				
20.	$-N=O$				
21.	$-CH_2X$				
22.	$-CHX_2$				

3. Devise a series of reactions to convert benzene into *meta*-chlorobromobenzene.
Select reagents and conditions from the following table, listing them in the order of use.

	Compound		Compound		Compound
1.	sulphuric acid (conc.) heat	**5.**	Mg in ether	**9.**	$Cu_2Br_2 + HBr$
2.	$Cl_2 + FeCl_3$ and heat	**6.**	PBr_3	**10.**	$(CH_3CO)_2O$ + Pyridine
3.	$NaNO_2 + H_3O^{(+)}$ 0°C	**7.**	H_3PO_2		
4.	H_2 Pt catalyst	**8.**	HNO_3(conc.)+ H_2SO_4(conc.) and heat		

(a) 1 then 2 then 6
(b) 2 then 8 then 4 then 3 then 9
(c) 8 then 4 then 10 then 2 then 3 then 9
(d) 8 then 2 then 4 then 3 then 9

4. Match the Column (I) and Column (II). (Matrix)

	Column (I)		Column (II)
(a)	Cl C N N Cl C N C — Cl	(p)	Aromatic
(b)	H N H — B B — H H N N — H B H	(q)	$(4n + 2)\pi$ electron in a single ring
(c)	$Fe(C_5H_5)_2$	(r)	$4n\pi$ electron in a single ring
(d)	$Cr(C_6H_6)_2$	(s)	Effective atomic number of metal = 36

5. Match the Column (I) and Column (II).

	Column (I)		Column (II)
	Compound (Monocyclic)		**Number of π - electron**
(a)	$C_4H_4^{-2}$	(p)	$2\pi e$
(b)	$C_4H_4^{+2}$	(q)	$6\pi e$
(c)	$C_9H_9^{+1}$	(r)	$8\pi e$
(d)	$C_9H_9^{-1}$	(s)	$10\pi e$

6. Match the Column (I), Column (II) and Column (III). (Matrix)

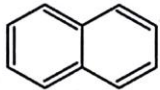
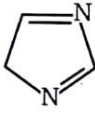
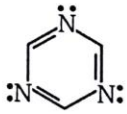
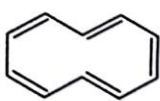
	Column I		Column II		Column III
(a)		(p)	Aromatic	(w)	$(4n+2)\pi$ electron. $n = 0, 1, 2, 3$
(b)		(q)	Non-aromatic	(x)	$4n\pi$ electron $n = 1, 2, 3$
(c)		(r)	Anti- aromatic	(y)	Non-planar compound
(d)		(s)	Planar compound	(z)	Readily reacts with active metal

7. Match the Column (I), Column (II) and Column (III). (Matrix)

	Column I		Column II		Column III
(a)		(p)	Readily react with active metal	(w)	Aromatic
(b)		(q)	Readily undergo Dimerization at room temperature	(x)	Anti-aromatic
(c)	−2	(r)	$(4n+2)\pi$ electron $n = 0, 1, 2, 3$	(y)	Non-aromatic
(d)	+2	(s)	$4n\pi$ electron	(z)	High dipole

8. Among the following compound.

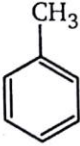
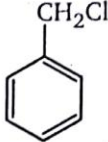
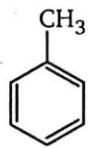
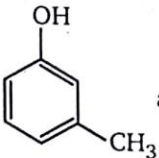
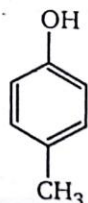
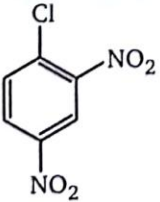
	Compound		Compound		Compound
(a)		**(b)**		**(c)**	N N N
(d)	N	**(e)**	+ +	**(f)**	
(g)	$C_8H_8^{-2}$	**(h)**	$C_3H_3^{+}$	**(i)**	OH +
(j)	N N	**(k)**	N	**(l)**	N

(a) Number of compounds which are aromatic $= P$
(b) Number of compounds which are anti-aromatic $= Q$
(c) Number of compounds which are non-aromatic $= R$
(d) Number of compounds which readily $= S$
Undergo dimerization at room temperature
(e) Number of compound which reacts with active metal $= T$
Sum of $P + Q + R + S + T =$

9. Of the following compounds which will react with Br_2 at room temperature in dark.

(a)	Benzene (C_6H_6)	
(b)	Cyclohexene (C_6H_{10})	
(c)	Cyclohexane (C_6H_{12})	
(d)	Propanoic Acid ($C_2H_5CO_2H$)	
(e)	Phenol (C_6H_5OH)	
(f)	Nitrobenzene ($C_6H_5NO_2$)	
(g)	Hexyne (C_6H_{10})	
(h)	2,2-dichloropropane ($C_3H_6Cl_2$)	

10. Among the following compound.

	Compound		Compound		Compound
(a)		(b)	$C_8H_8^{-2}$	(c)	
(d)		(e)	N N	(f)	
(g)		(h)	:N̈ :N N:	(i)	$C_3H_3^{+1}$
(j)	OH ⊕	(k)	N	(l)	

(a) Number of compounds which are aromatic = w

(b) Number of compounds which are non-aromatic = x

(c) Number of compounds which are anti-aromatic = y

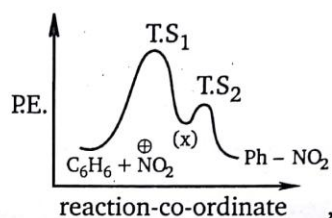
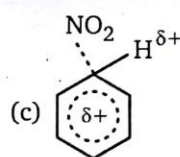
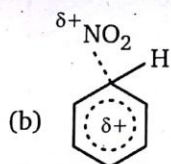
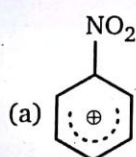
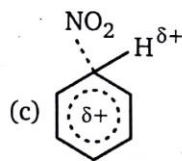
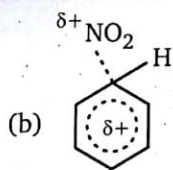
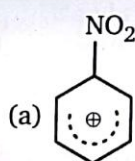
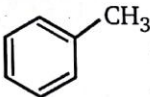
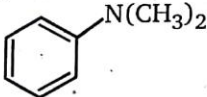
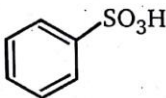
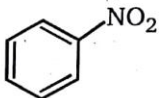
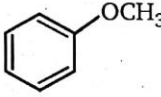
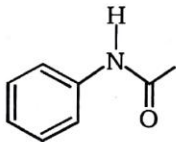
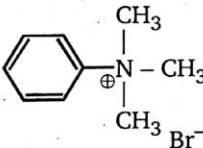
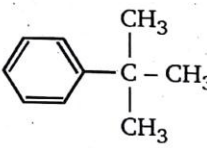
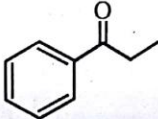
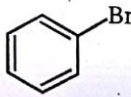
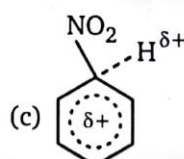
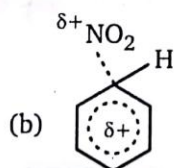
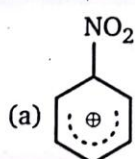
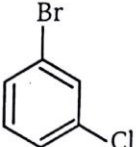
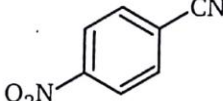
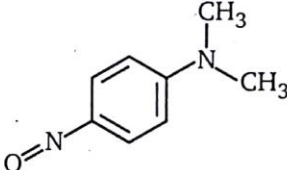
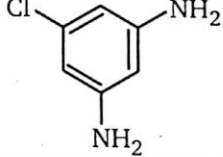
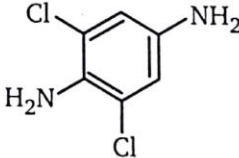
(d) Number of compounds which readily undergo Dimerization at room temperature = z

Sum of $w + x + y + z = ...$

11. Complete the following table.

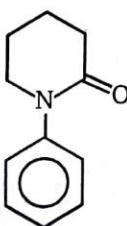
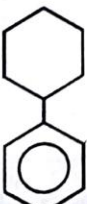
	Reactant	Reagents(s)/Conditions	Major Organic Products
(a)	$C_6H_5CH_3$ (toluene)	**(A)**	$C_6H_5CH_2Cl$
(b)	NH_2 / NO_2 (para-substituted benzene)	1. $NaNO_2$ in dilute H_2SO_4/0 – 5°C 2. heat or boiling	**(B)**
(c)	$C_6H_5CH_3$ (toluene)	SO_3/conc. H_2SO_4	**(C)**
(d)	**(D)**	1. NaOH heated at 330°C 2. dilute H_3O^+	OH / CH_3 (meta) and OH / CH_3 (para)
(e)	Cl / NO_2 / NO_2 (2,4-dinitro-substituted chlorobenzene)	1. aqueous NaOH heated at 60°C 2. dilute H_3O^+	**(E)**

12. Comprehension

Given is the energy profile diagram of nitration of benzene using mixed acid. ($HNO_3 + H_2SO_4$).

A. Identify (x) in above reaction :

B. Identify $T.S_1$ in the above reaction.

C. Identify $T.S_2$ in the above reaction :

13. Examine the ten structural formulas shown below and select those that satisfy each of the following conditions. Enter one or more letters (a through j) in each answer box, reflecting your choice for each.

	Compound		Compound
a.	CH_3	**b.**	$N(CH_3)_2$
c.	SO_3H	**d.**	NO_2
e.	OCH_3	**f.**	H, N, O
g.	CH_3, $\oplus N - CH_3$, CH_3 Br^-	**h.**	CH_3, $C - CH_3$, CH_3
i.	O	**j.**	Br

A.	Which compounds undergo electrophilic nitration more rapidly than benzene ?	
B.	Which compounds give meta substitution under electrophilic bromination conditions ?	

14. Nitrobenzene is a versatile compound that may be converted into a wide variety of substituted benzenes. Five such synthesis are shown below. In each reaction box above an arrow write letters designating the reagents and conditions, selected from the list at the bottom of the page, that would effect the transformation. The reagents must be written in the answer box in the correct order of their use. You may assume appropriate heating or cooling takes place, and more than one equivalent of the reagent may be used if needed.

Reactant		Reagent		Product
nitrobenzene ($C_6H_5NO_2$)	a.	⟶	v.	1-bromo-3-chlorobenzene (Br, Cl)
	b.	⟶	w.	4-nitrobenzonitrile (O_2N, CN)
	c.	⟶	x.	N,N-dimethyl-4-nitrosoaniline ($O{=}N$, $N(CH_3)_2$)
	d.	⟶	y.	5-chloro-1,3-benzenediamine (Cl, NH_2, NH_2)
	e.	⟶	z.	4,6-dichloro-1,3-benzenediamine (Cl, NH_2, H_2N, Cl)

	Reagents		Reagents
A.	H_2, Ni catalyst	**F.**	Cl_2 & $FeCl_3$
B.	KBr & Cu_2Br_2	**G.**	NaOH 10% solution
C.	KCN & $Cu_2(CN)_2$	**H.**	$(CH_3CO)_2O$, pyridine
D.	HNO_2 0°C	**I.**	HNO_3/H_2SO_4
E.	CH_3I & pyridine		

15. Match the column I and II.

	Column (I)		Column (II)
	Group		**Effect on phenyl ring**
(a)	$-CH=CH-CO_2H$	**(p)**	*o*/*p*-directors
(b)	$-O-\overset{O}{\overset{\|}{S}}-CH_3$	**(q)**	meta-directors
(c)	$-NH-\overset{O}{\overset{\|}{C}}-CH_3$	**(r)**	Activating group
(d)	$-\underset{\underset{O}{\|}}{S}-CH_3$	**(s)**	De-activating group

16. Match the column I and II.

	Column (I)		Column (II)
	Group		**Effect on phenyl group**
(a)	N, O	**(p)**	Activating group
(b)		**(q)**	De-activating group

(c)	$O-CH=CH_2$ attached to benzene ring	(r)	*o/p*-director
(d)	S–Et attached to benzene ring	(s)	meta-director

17. Comprehension

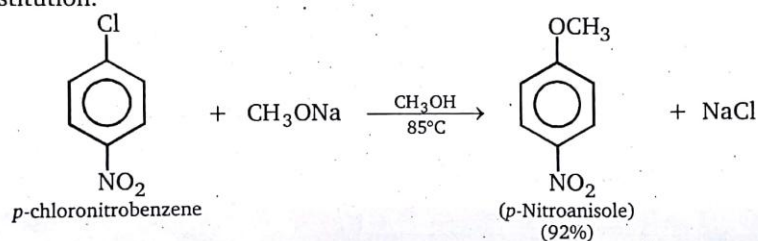
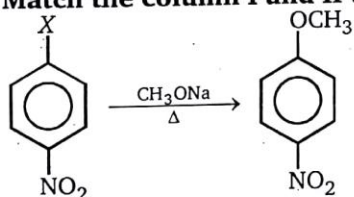
Nucleophilic Aromatic substitution (SN_{Ar}) :

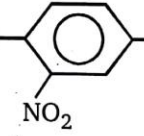
A substituted benzene derivative containing- NO_2 and Cl group at *p*-position is subjected to Nu-substitution.

$$p\text{-}ClC_6H_4NO_2 + CH_3ONa \xrightarrow[85°C]{CH_3OH} p\text{-}CH_3OC_6H_4NO_2 + NaCl$$

p-chloronitrobenzene → (*p*-Nitroanisole) (92%)

A. Match the column I and II :

$$p\text{-}XC_6H_4NO_2 \xrightarrow[\Delta]{CH_3ONa} p\text{-}CH_3OC_6H_4NO_2$$

	Column (I)		Column (II)
	X = halogen		relative reactivity toward (SN_{Ar}).
(a)	– F	(p)	312
(b)	– Cl	(q)	1
(c)	– Br	(r)	0.8
(d)	– I	(s)	0.6

B. If step-2 were rate determining step, which halogen of aryl halide is most reactive toward SN_{Ar}.

(a) Fluoride (b) Chloride (c) Bromide (D) Iodide

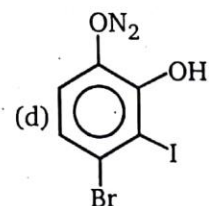
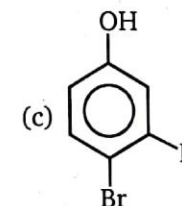
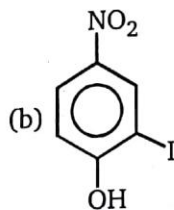
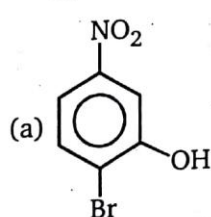
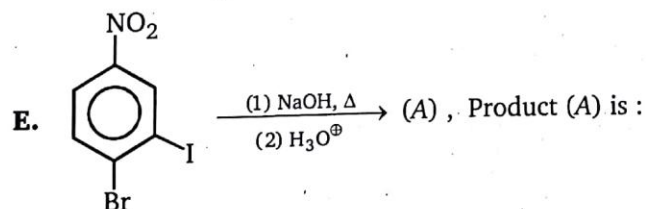
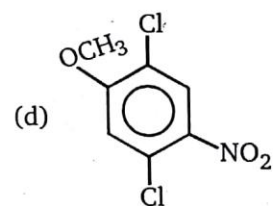
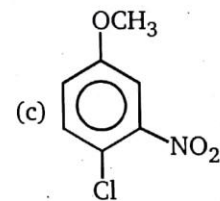
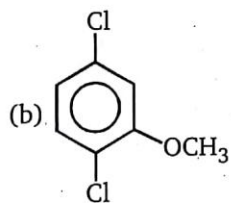
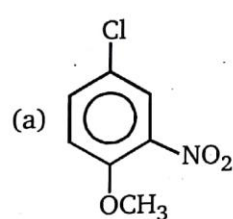
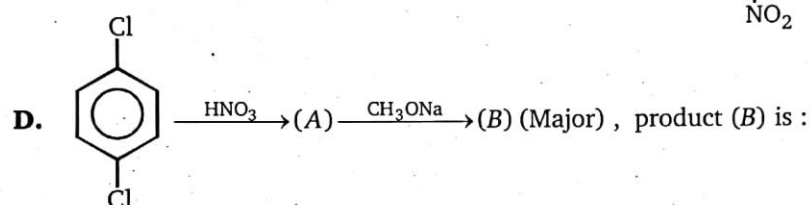
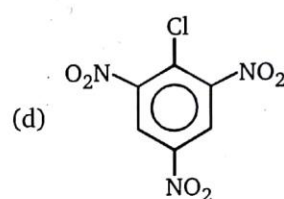
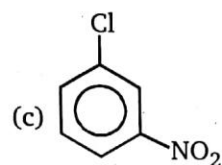
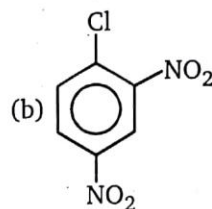
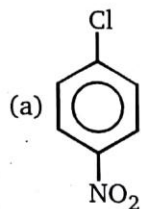
C. Which of the following is most reactive toward SN_{Ar}.

(a) Cl, NO_2 (b) Cl, NO_2, NO_2 (c) Cl, NO_2 (d) Cl, O_2N, NO_2, NO_2

D. Cl, Cl $\xrightarrow{HNO_3}$ (A) $\xrightarrow{CH_3ONa}$ (B) (Major), product (B) is :

(a) Cl, NO_2, OCH_3 (b) Cl, OCH_3, Cl (c) OCH_3, NO_2, Cl (d) OCH_3, Cl, NO_2, Cl

E. NO_2, I, Br $\xrightarrow[(2)\ H_3O^{\oplus}]{(1)\ NaOH,\ \Delta}$ (A), Product (A) is :

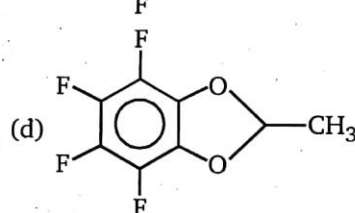
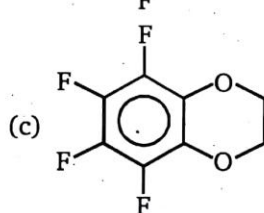
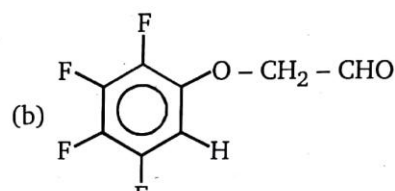
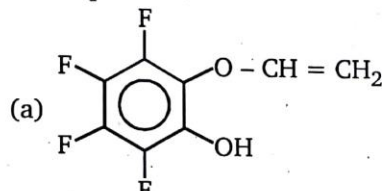
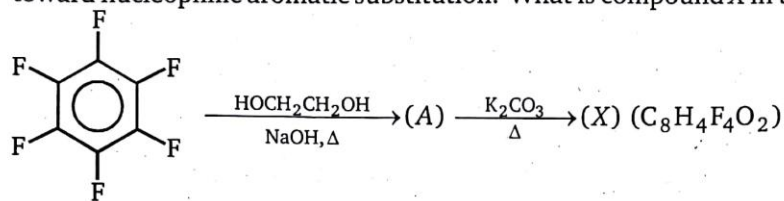
(a) NO_2, OH, Br (b) NO_2, I, OH (c) OH, I, Br (d) ON_2, OH, I, Br

F. The cumulative effect of their fluorine activate the rings of penta and hexa fluorobenzene toward nucleophilic aromatic substitution. What is compound *X* in the following synthesis ?

Hexafluorobenzene $\xrightarrow[\text{NaOH, }\Delta]{HOCH_2CH_2OH}$ (*A*) $\xrightarrow[\Delta]{K_2CO_3}$ (*X*) ($C_8H_4F_4O_2$)

(a) tetrafluoro ring with $O-CH=CH_2$ and OH

(b) F, F, F, F ring with $O-CH_2-CHO$ and H

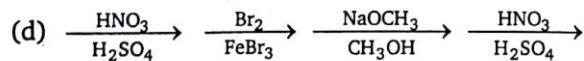
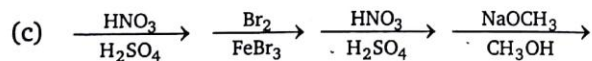
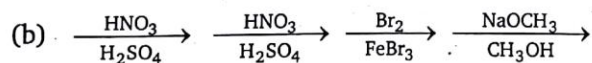
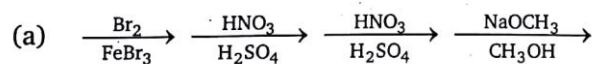
(c) tetrafluoro ring fused with $-O-CH_2-CH_2-O-$ (six-membered dioxane ring)

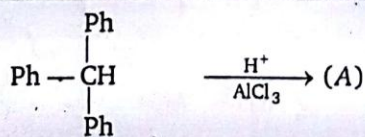
(d) tetrafluoro ring fused with $-O-CH(CH_3)-O-$ (five-membered ring) bearing CH_3

G. Which is the best route for the synthesis of CH_3O–$C_6H_3(NO_2)$–NO_2 (2,4-dinitroanisole) Strating from benzen of ?

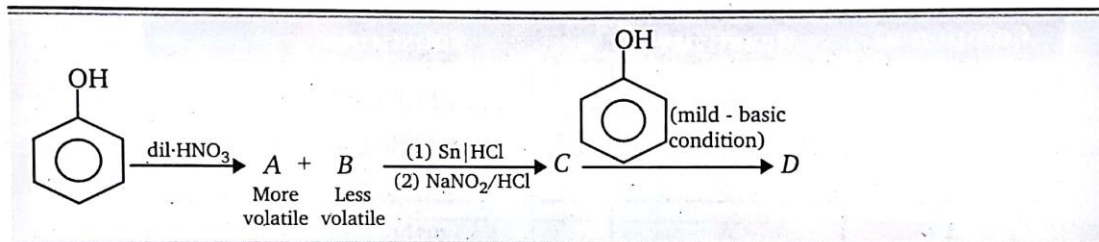
(a) $\xrightarrow[FeBr_3]{Br_2}$ $\xrightarrow[H_2SO_4]{HNO_3}$ $\xrightarrow[H_2SO_4]{HNO_3}$ $\xrightarrow[CH_3OH]{NaOCH_3}$

(b) $\xrightarrow[H_2SO_4]{HNO_3}$ $\xrightarrow[H_2SO_4]{HNO_3}$ $\xrightarrow[FeBr_3]{Br_2}$ $\xrightarrow[CH_3OH]{NaOCH_3}$

(c) $\xrightarrow[H_2SO_4]{HNO_3}$ $\xrightarrow[FeBr_3]{Br_2}$ $\xrightarrow[H_2SO_4]{HNO_3}$ $\xrightarrow[CH_3OH]{NaOCH_3}$

(d) $\xrightarrow[H_2SO_4]{HNO_3}$ $\xrightarrow[FeBr_3]{Br_2}$ $\xrightarrow[CH_3OH]{NaOCH_3}$ $\xrightarrow[H_2SO_4]{HNO_3}$

18. Identify product (*A*) and write its structure.

Ph_3CH (Ph–CH with two Ph) $\xrightarrow[AlCl_3]{H^+}$ (*A*)

SUBJECTIVE PROBLEMS

1.

Double bond equivalent of D is :

2. How many isomers 'x' of C_8H_{10} when reacts with hot alkaline $KMnO_4$ give only aromatic dicarboxylic acid ? How many isomers 'y' of C_4H_8 when reacts with hot alkaline $KMnO_4$ give carbondioxide ?

Sum of $x+y=$?

3. How many groups are o/p director in the electrophilic aromatic substitution ?

(i) $—NH_2$	(ii) —COH	(iii) —N=O	(iv) —COOH
(v) —OMe	(vi) —O—C(=O)—Me	(vii) —Et	(viii) —C(=O)—NH—Me
(ix) $—N=NH_2$	(x) $—SO_3H$		

ANSWERS — LEVEL 2

1.

Compound	Reactivity	Substitution
1	B	ortho/para
2	A	ortho/para
3	B	ortho/para
4	A	ortho/para
5	B	meta
6	B	ortho/para

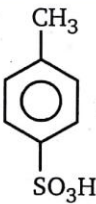
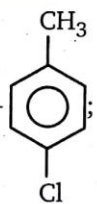
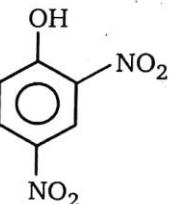
2.

	Substituent	Activating	De-activating	Ortho/para	Meta
1.	$-OCH_3$	✓	✗	✓	✗
2.	$-C(=O)-O-CH_3$	✗	✓	✗	✓
3.	$-O-C(=O)-CH_3$	✓	✗	✓	✗
4.	$-CH_3$	✓	✗	✓	✗
5.	$-F$	✗	✓	✓	✗
6.	$-Ph$	✓	✗	✓	✗
7.	$-NH-C(=O)-CH_3$	✓	✗	✓	✗
8.	$-C(=O)-NH-CH_3$	✗	✓	✗	✓
9.	$-Br$	✗	✓	✓	✗
10.	$-CN$	✗	✓	✗	✓

11.	$-CF_3$	✗	✓	✗	✓
12.	$-\overset{O}{\overset{\|\|}{C}}-NH_2$	✗	✓	✗	✓
13.	$-\overset{O}{\overset{\|\|}{C}}-OH$	✗	✓	✗	✓
14.	$-CH=CH_2$	✓	✗	✓	✗
15.	$-CH=CH-\overset{O}{\overset{\|\|}{C}}-OH$	✗	✓	✓	✗
16.	$-CH=CH-\overset{O}{\overset{\|\|}{C}}-H$	✗	✓	✓	✗
17.	$-S-Et$	✓	✗	✓	✗
18.	$-\underset{O}{\underset{\|\|}{S}}-Et$	✗	✓	✓	✗
19.	$-\overset{O}{\overset{\|\|}{\underset{O}{\underset{\|\|}{S}}}}-Et$	✗	✓	✗	✓
20.	$-N=O$	✗	✓	✓	✗
21.	$-CH_2X$	✗	✓	✗	✓
22.	$-CHX_2$	✗	✓	✗	✓

3. d

4. a – p, q; b – p, q; c – p, q,s ; d – p, q, s

5. a – q; b – p; c – r; d – s

6. a – p, s – w; b – p, s – w; c – q – x, y, z; d – q – w – y

7. a – p, q, s – x; b – p – s – y; c – r – w, z; d – r – w, z

8. $P+Q+R+S+T=19$

9. b, e, g

10. $w+x+y+z=14$

11. A – $Cl_2/h\nu$ or $SO_2Cl_2/h\nu$; B – (OH, NO_2); C – (CH_3, SO_3H); D – (CH_3, Cl); E – (OH, NO_2, NO_2)

12. A – a; B – b; C – c

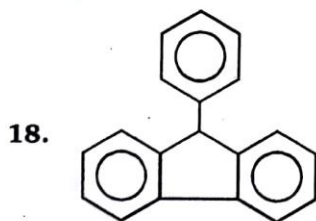
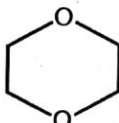
13. A – a, b, e, f, h; B – c, d, g, i (Note : yet C_6H_5Br is less reactive than C_6H_6 but *o*/*p* directing)

14. v – F, A, D, B; w – A, H, I, G, D, C; x – A, E, D; y – F, I, A or I, F, A;
z – A, H, I, F, G, A or A, H, I, F, A, G

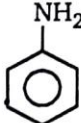
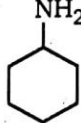
15. a – p, s; b – p, r; c – p, r; d – p, s

16. a – p, r; b – p, r; c – p, r; d – p, r

17. A –a – p, b – q, c – r, d – s; B – d; C – d; D – a; E – b; F – c; G – a

18.

Subjective Problems

1. 9 **2.** 5 **3.** 6

13 PRACTICAL ORGANIC CHEMISTRY

LEVEL-1

1. (X) and (Y); Compounds (X) and (Y) can be differentiated by :

(a) $H_3O^{\oplus}$, NaOI
(b) $H_3O^{\oplus}$, then Fehling test
(c) $H_3O^{\oplus}$, then Na
(d) Both (b) and (c)

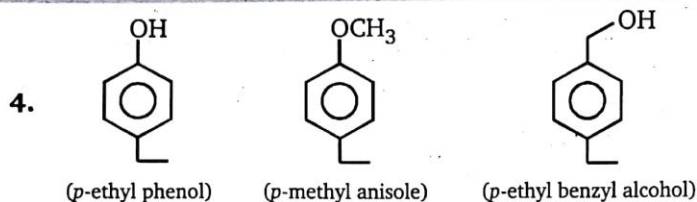
2. Compound $CH_3 - CH(OEt)_2$ (P) (Acetal) and $CH_3 - CH_2 - O - CH_2 - CH_3$ (Q) can be differentiated by :

(a) $H_3O^{\oplus}$, Na
(b) $H_3O^{\oplus}$, Tollens' test
(c) $H_3O^{\oplus}$, Fehling test
(d) All of these

3. NH_2 (aniline) and NH_2 (cyclohexyl amine) can be differentiated by :

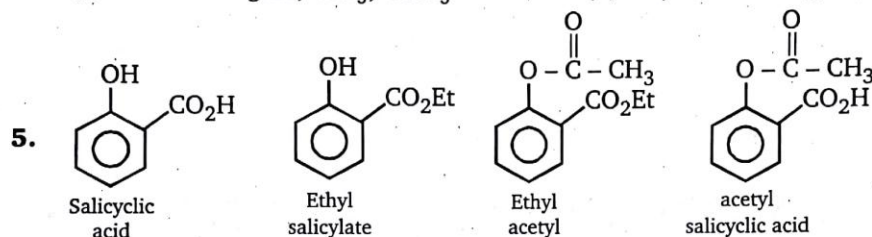
(a) Hinsberg test
(b) Iso-cyanide test
(c) $NaNO_2$, HCl, then β-Naphthol
(d) NaOH

4.

(*p*-ethyl phenol) (*p*-methyl anisole) (*p*-ethyl benzyl alcohol)

Above compounds can be differentiated by using the reagent:

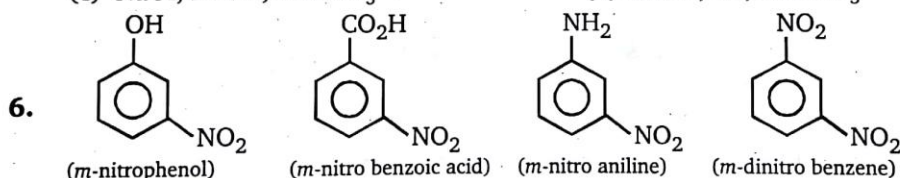
(a) NaOH, Tollen's reagent, $FeCl_3$
(b) CrO_3, Tollen's reagent, $FeCl_3$
(c) Tollen's reagent, CrO_3, $FeCl_3$
(d) Na, Tollen's reagent, $FeCl_3$

5.

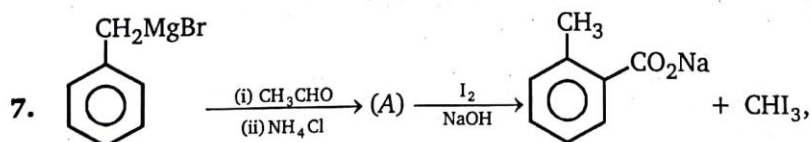
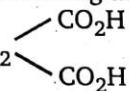
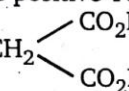
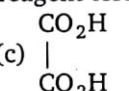
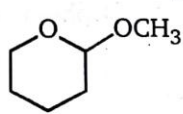
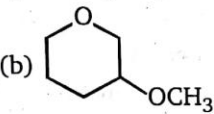
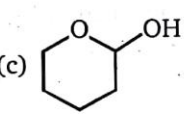
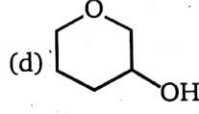
Salicyclic acid | Ethyl salicylate | Ethyl acetyl | acetyl salicyclic acid

Above compounds can be differentiated by the salicylate. Which of the following chemical test? (used in decreasing order)

(a) NaOH, $FeCl_3$, $NaHCO_3$
(b) aq. $NaHCO_3$, $FeCl_3$, NaOH
(c) NaOI, NaOH, $NaHCO_3$
(d) NaOH, Na, $NaHCO_3$

6. NO_2–C_6H_4–NO_2

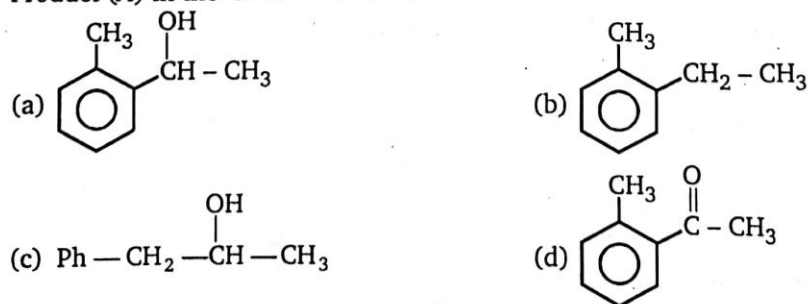
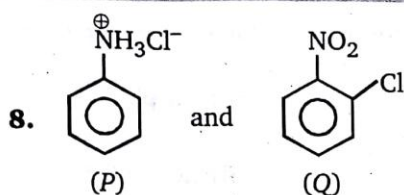
(*m*-nitrophenol) (*m*-nitro benzoic acid) (*m*-nitro aniline) (*m*-dinitro benzene)

Above compounds can be differentiated by which of the following chemical test ? (used in decreasing order)

(a) NaOH, $NaHCO_3$, HCl
(b) HCl, NaOH, $NaHCO_3$
(c) $NaHCO_3$, NaOH, HCl
(d) NaOH, HCl, $NaHCO_3$

7. $C_6H_5CH_2MgBr \xrightarrow[\text{(ii) } NH_4Cl]{\text{(i) } CH_3CHO} (A) \xrightarrow[NaOH]{I_2}$ (*o*-CH_3–C_6H_4–CO_2Na) + CHI_3,

Product (*A*) in the above reaction is :

(a) *o*-CH_3–C_6H_4–$CH(OH)-CH_3$
(b) *o*-CH_3–C_6H_4–CH_2-CH_3
(c) $Ph-CH_2-CH(OH)-CH_3$
(d) *o*-CH_3–C_6H_4–$C(=O)-CH_3$

8. $\overset{\oplus}{N}H_3Cl^-$ (benzene ring) and NO_2, Cl (benzene ring)

(P) (Q)

Above compounds (P) & (Q) can be differentiated by :

(a) amm. $AgNO_3$ (b) NaOH
(c) $FeCl_3$ (d) Both (a) & (b)

9. Which of following acid give positive Tollen's reagent test.

(a) $(CH_2)_2(CO_2H)_2$ (b) $CH_2(CO_2H)_2$ (c) CO_2H–CO_2H (d) HCO_2H

10. Which of following compounds give positive Tollen's test?

(a) 2-OCH_3 tetrahydropyran (b) 3-OCH_3 tetrahydropyran (c) 2-OH tetrahydropyran (d) 3-OH tetrahydropyran

11. Give a simple test to differentiate cyclohexane and cyclohexene

(a) Br_2/H_2O (b) Bayer's reagent
(c) Tollen's reagent (d) Both (a) and (b)

12. Give test to differentiate (Bromobenzene) Ph – Br and benzyl bromide ($PhCH_2Br$).

(a) (i) aq. KOH (ii) Na (b) $AgNO_3$
(c) $KMnO_4$ (d) All these

13. Give test to differetiate 1,1-dichloroethane and 1, 2-dichloroethane :

(a) 2,4 -DNP then aq. KOH (b) aq. KOH then 2, 4-DNP
(c) $NaHSO_3$ (d) Lucas reagent

14. Test to differentiate between (CH_3OH) (methanol) and (Ph – OH) (Phenol) is/are :

(a) Litmus test (b) $FeCl_3$
(c) Br_2/H_2O (d) All of these

15. Acetaldehyde and benzaldehyde can be differentiated by :

(a) Fehling test (b) Iodoform test
(c) Tollen's reagent (d) both (a) and (b)

16. Ethylamine and diethylamine cannot be differentiated by :

(a) Hinsberg test (b) carbylamine test
(c) Iodoform test (d) both (a) and (b)

17. Lassaigne's test for the detection of nitrogen will fail in the case of :

(a) NH_2CONH_2 (b) $NH_2CONHNH_2 . HCl$
(c) $NH_2NH_2 . HCl$ (d) $C_6H_5NHNH_2 .\ 2HCl$

18. Sodium nitroprusside when added to an alkaline solution of sulphide ions produces a colouration which is :

(a) red (b) blue (c) brown (d) purple

19. In Kjeldahl's method, nitrogen present is estimated as :

(a) N_2 (b) NH_3 (c) NO_2 (d) none of these

20. In Kjeldahl's method of estimation of nitrogen, K_2SO_4 acts as :

(a) an oxidising agent (b) catalytic agent
(c) hydrolysing agent (d) boiling point elevator

21. The prussian blue colour obtained during the test of nitrogen by Lassaigne's test is due to the formation of :

(a) $Fe[Fe(CN)_6]_3$ (b) $Na_3[Fe(CN)_6]$
(c) $Fe(CN)_3$ (d) $Na_4[Fe(CN)_5NOS]$

22. A compound which does not give a positive test in Lassaigne's test for nitrogen is:

(a) urea (b) hydrazine (c) azobenzene (d) phenyl hydrazine

23. *p*-nitrophenol and *o*-nitrophenol are separated by :

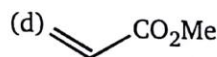
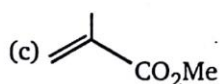
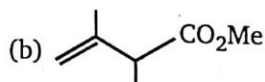
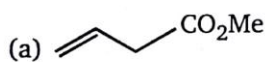
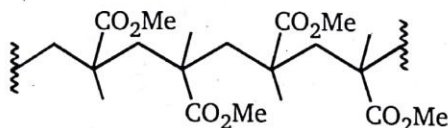
(a) distillation (b) steam distillation
(c) crystallization (d) fractional crystallization

24. Which of the following reagent is used for the separation of acetaldehyde from acetophenone ?

(a) NH_2OH (b) NaOI (c) Tollen's reagent (d) $C_6H_5NHNH_2$

25. The formula of gas is $[CO]_x$. If its vapour density is 70, the value of x will be :

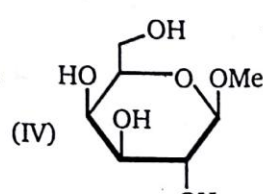
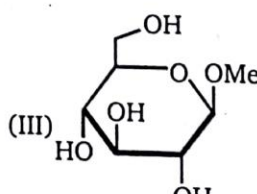
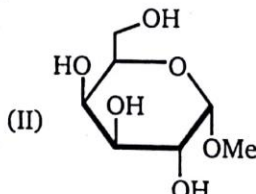
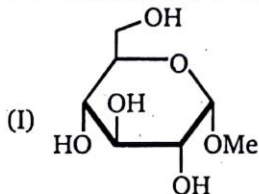
(a) 2.5 (b) 3.0 (c) 5.0 (d) 6.0

26. The structure of the monomer that would give the following polymer by an addition mechanism is :

CO₂Me CO₂Me
CO₂Me CO₂Me

(a) CO_2Me (b) CO_2Me

(c) CO_2Me (d) CO_2Me

27. Identify the correct set of stereochemical relationships amongst the following monosaccharides I – IV

(I) OH, O, OH, HO, OMe, OH (II) OH, HO, O, OH, OMe, OH (III) OH, O, OMe, OH, HO, OH (IV) OH, HO, O, OMe, OH, OH

(a) I and II are anomers ; III and IV are epimers
(b) I and II are epimers ; III and IV are anomers
(c) I and III are anomers ; I and II are epimers
(d) I and III are epimers ; II and IV are anomers

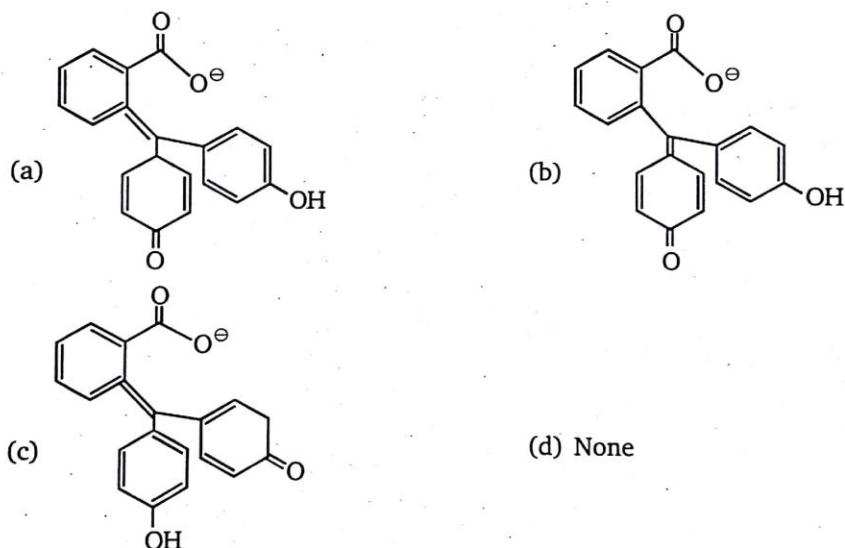
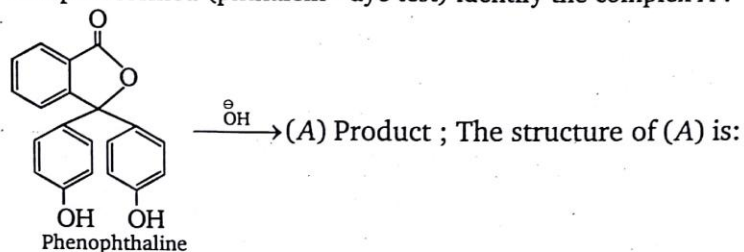
28. A dye, phenolphtnalein is prepared by reacting phenol with phthalic anhydride in acidic medium. It give pink colour in alkaline medium due to extended conjugation in a new complex formed (phthalein - dye test) identify the complex *A* :

Phenophthaline $\xrightarrow{\overset{\ominus}{O}H}$ (*A*) Product ; The structure of (*A*) is:

(a)

(b)

(c)

(d) None

ANSWERS — LEVEL 1															
1.	(d)	**2.**	(d)	**3.**	(c)	**4.**	(b)	**5.**	(b)	**6.**	(c)	**7.**	(a)	**8.**	(d)
9.	(d)	**10.**	(c)	**11.**	(d)	**12.**	(d)	**13.**	(b)	**14.**	(d)	**15.**	(d)	**16.**	(c)
17.	(c)	**18.**	(b)	**19.**	(b)	**20.**	(d)	**21.**	(d)	**22.**	(b)	**23.**	(a)	**24.**	(c)
25.	(c)	**26.**	(c)	**27.**	(c)	**28.**	(b)								

LEVEL-2

1. Comprehension

Given are the isomers of $C_8H_8O_2$.

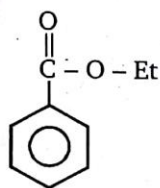
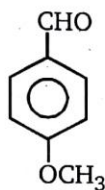
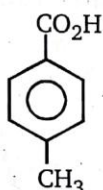
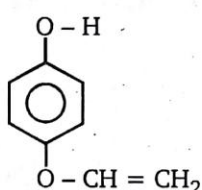
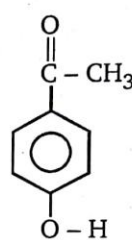
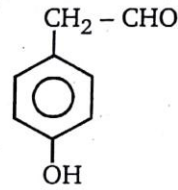
(a) $C_6H_5-C(=O)-O-Et$

(b) p-$CH_3O-C_6H_4-CHO$

(c) p-$CH_3-C_6H_4-CO_2H$

(d) p-$CH_2=CH-O-C_6H_4-O-H$

(e) p-$H-O-C_6H_4-C(=O)-CH_3$

(f) p-$HO-C_6H_4-CH_2-CHO$

A. Which isomer gives positive iodoform test ?

(a) a (b) b
(c) d (d) e

B. Which isomer gives +ive Tollen's test, also reacts with $FeCl_3$?

(a) b (b) f
(c) c (d) d

C. Which isomer reacts with $NaHCO_3$?

(a) c (b) d
(c) e (d) f

D. Which isomer on hydrolysis gives 1, 4-di hydroxybenzene ?

(a) a (b) d
(c) e (d) f

2. $Ph-\overset{O}{\overset{\|}{C}}-OH \xrightarrow{NaH\overset{14}{C}O_3} (A)\text{gas}$; $Ph-OH \xrightarrow{Na} (B)\text{gas}$

Sum of molecular mass of gas $(A+B=?)$

ANSWERS — LEVEL 2

1. A – d; B – b; C – a; D – b
2. 48

14 BIOMOLECULES

1. Which statement correctly completes the statement ?

   Except for glycine, which is achiral, all the amino acids present in proteins ......

   (a) are chiral, but racemic
   (b) have the L configuration at their α carbon
   (c) have the R configuration at their α carbon
   (d) have the S configuration at their α carbon

2. Assume that a particular amino acid has an isoelectric point of 6.0. In a solution at pH 1.0, which of the following species will predominate ?

   (a) $H_3\overset{+}{N}CH(R)CO_2H$ (b) $H_2NCH(R)CO_2H$
   (c) $H_3\overset{+}{N}CH(R)CO_2^-$ (d) $H_2NCH(R)CO_2^-$

3. The pK_a values for the three ionizable groups X, Y and Z of glutamic acid are 4.3, 9.7 and 2.2 respectively

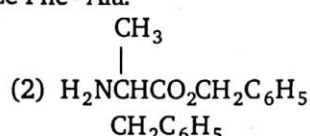
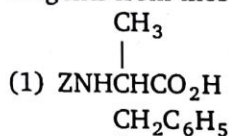
$$\underset{X}{HO_2C}-CH_2-\underset{\underset{+NH_3}{|}}{CH}-\underset{Z}{CO_2H}$$

   The isoelectric point for the amino acid is :

   (a) 7.00 (b) 3.25 (c) 4.95 (d) 5.95

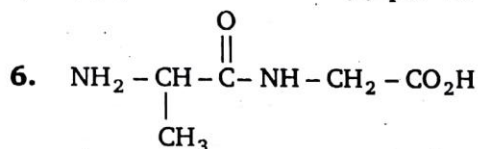
4. An amino acid may be represented by general formula $H_2N-\underset{|}{\overset{R}{C}}H-COOH$. If $R = -CH_2C_6H_5$ then it is phenylalanine (Phe) and if $R = CH_3$ then it is alanine (Ala). Find the sequence of reagents from those given below to synthesize Phe- Ala.

(1) $ZNH\overset{CH_3}{\overset{|}{C}}HCO_2H$ (2) $H_2N\overset{CH_3}{\overset{|}{C}}HCO_2CH_2C_6H_5$

(3) $ZNH\overset{CH_2C_6H_5}{\overset{|}{C}}HCO_2H$ (4) $H_2N\overset{CH_2C_6H_5}{\overset{|}{C}}HCO_2CH_2C_6H_5$

(a) 1 and 2 (b) 1 and 4 (c) 2 and 3 (d) 3 and 4

5. Iso-electric point of alanine is (pH = 6). At which pH, maximum concentration of zwitter ion of alanine will be present ?

(a) pH > 6 (b) pH < 6 (c) pH = 6 (d) pH = 7

6. $NH_2-\underset{CH_3}{\underset{|}{C}}H-\overset{O}{\overset{||}{C}}-NH-CH_2-CO_2H$

Identify the amino acid obtained by hydrolysis of the above compound:

(a) Glycine (b) Alanine (c) Both (a) and (b) (d) None of these

7. At iso-electric point :

(a) conc. of cation is equal to conc of anion

(b) Net charge is zero.

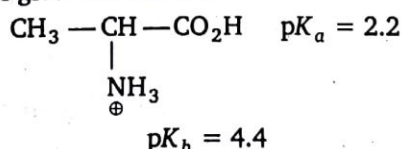
(c) Maximum conc. of di-polar ion (Zwitter ion) will be present

(d) All of the above

8. Which of following amino acid has lowest iso-electric point ?

(a) Glycine (b) Alanine (c) Aspartic acid (d) Lysine

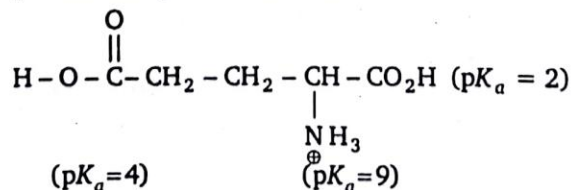
9. Find iso-electric point of given amino acid

$$CH_3-\underset{\overset{\oplus}{N}H_3}{\underset{|}{C}}H-CO_2H \quad pK_a = 2.2$$

$$pK_b = 4.4$$

(a) 3.3 (b) 5.9 (c) 9.6 (d) 11.8

10. Find iso-electric point of the given amino acid

$$H-O-\overset{O}{\overset{||}{C}}-CH_2-CH_2-\underset{\overset{\oplus}{N}H_3}{\underset{|}{C}}H-CO_2H \ (pK_a = 2)$$

$$(pK_a{=}4) \qquad (pK_a{=}9)$$

(a) 5.5 (b) 6.5 (c) 3 (d) 5

11. $H-C\equiv C-H \xrightarrow[H_2SO_4]{HgSO_4} (A) \xrightarrow[(2)\ H_3O^{\oplus}]{(1)\ NH_3+HCN} (B)$; Product (*B*) of given reaction is :

(a) Glycine (b) Alanine
(c) valine (d) Leucine

12. Which amino acid does not contain chiral centre ?

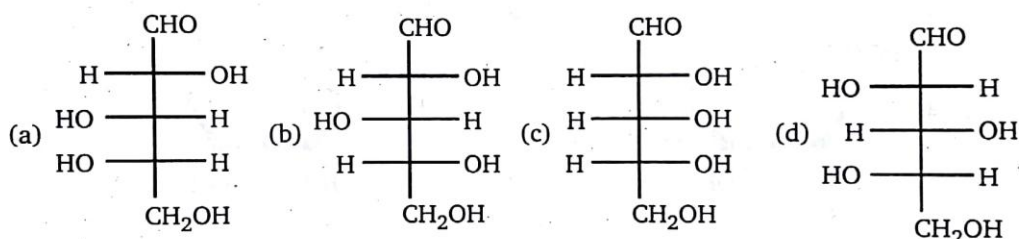
(a) Valine (b) Leucine (c) Glycine (d) Iso-leucine

13. Which of the following is Sanger reagent ?

(a) 2,4-Di-nitro flurobenzene (b) Phenyl isocyanate
(c) 2, 4-Di-nitro chlorobenzene (d) 2, 4-Di-nitro iodobenzene

14. A D-carbohydrate is :

(a) Always dextrorotatory
(b) Always laevorotatory
(c) Always the mirror of the corresponding L-carbohydrate
(d) None of these

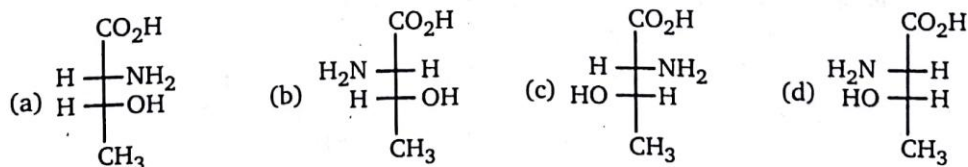
15. Which L-sugar on oxidation gives an optically active dibasic acid (2 COOH groups) ?

16. HO—H, H—OH, H—OH, CH_2OH The given osazone can be obtained by :

(a) D-glucose (b) D-mannose (c) D-Idose (d) Both (a) & (b)

17. Which of the following pair gives same phenyl osazone ?

(a) D-Glucose and D-Allose (b) D-Glucose and D-Alfrose
(c) D-Glucose and D-Mannose (d) D-Glucose and D-Talose

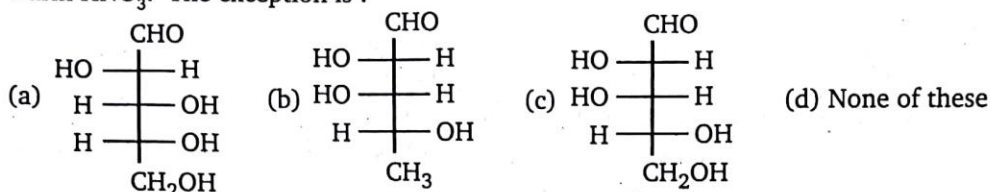
18. Which of the following is the Fischer projection of L-threonine (also known as (2S, 3R)-2-amino-3-hydroxybutanoic acid) ?

(a) CO_2H; H—NH_2; H—OH; CH_3
(b) CO_2H; H_2N—H; H—OH; CH_3
(c) CO_2H; H—NH_2; HO—H; CH_3
(d) CO_2H; H_2N—H; HO—H; CH_3

19. Among the three compounds shown below, two yield the same product on reaction with warm HNO_3. The exception is :

(a)

(b)
CHO
HO — H
HO — H
H — OH
CH_3

(c)

(d) None of these

20. The optical rotation of the α- form of a pyranose is + 150.7°, that of the β- form is + 52.8°. In solution an equilibrium mixture of these anomers has an optical rotation of + 80.2°. The percentage of the α-form in equilibrium mixture is :

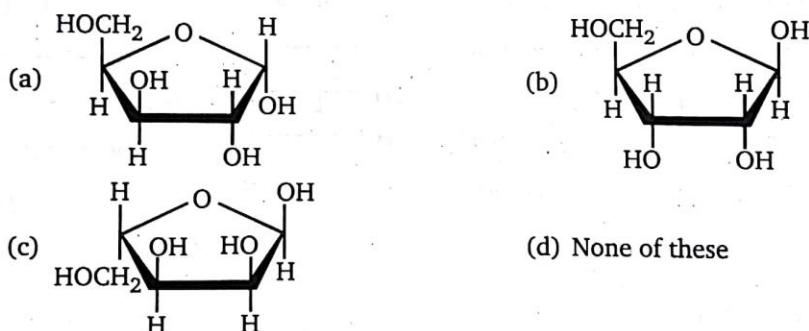
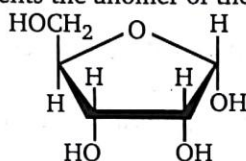
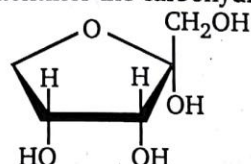
(a) 28% (b) 32 % (c) 68% (d) 72%

21. Which of the following represents the anomer of the compound shown ?

(a)

(b)

(c)
H O OH
OH HO
$HOCH_2$ H
H H

(d) None of these

22. Which set of terms correctly identifies the carbohydrate shown ?

(1) Pentose (2) Pentulose (3) Hexulose (4) Hexose
(5) Aldose (6) Ketose (7) Pyranose (8) Furanose

(a) 2, 6, 8 (b) 2, 6, 7
(c) 1, 5, 8 (d) A set of terms other than these

23. For the complex conversion of D-glucose into the corresponding osazone, the minimum number of equivalents of phenyl hydrazine required is :

(a) two (b) three (c) four (d) five

24. Which one of the following compounds will form an osazone derivative ?

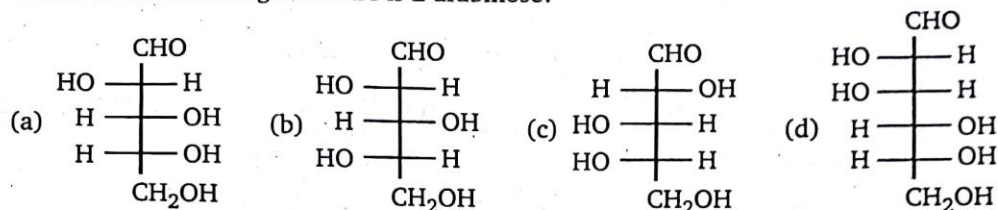
(a) $CH_3CH_2COCH_2OH$ (b) $CH_3COCH_2CH_2OH$
(c) $CH_3CH_2CHOHCH_2OH$ (d) $CH_3CH_2COCH_2OCH_3$

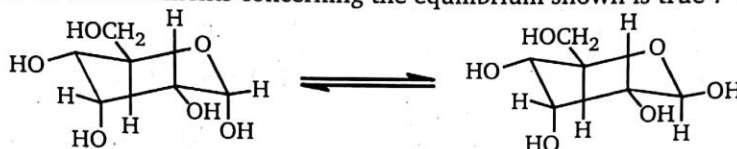
25. Which of the following structure is L-arabinose?

(a)
CHO
HO — H
H — OH
H — OH
CH_2OH

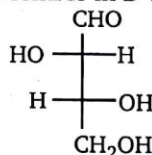
(b)
CHO
HO — H
H — OH
HO — H
CH_2OH

(c)
CHO
H — OH
HO — H
HO — H
CH_2OH

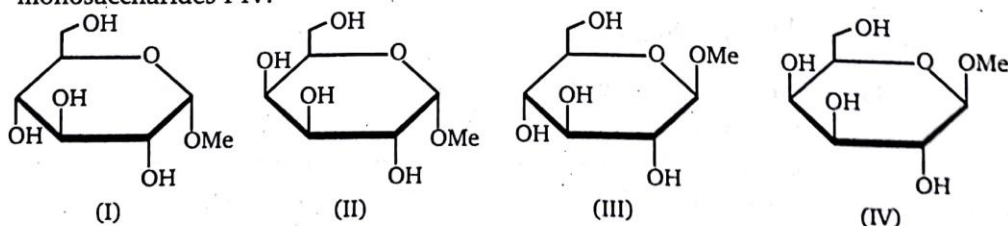
(d)
CHO
HO — H
HO — H
H — OH
H — OH
CH_2OH

26. Which one of the statements concerning the equilibrium shown is true ?

$HOCH_2$, H, O, HO, H, H, OH, HO, H, OH ⇌ $HOCH_2$, H, O, HO, H, OH, OH, HO, H, H

(a) The two structures are enantiomers of each other. They have equal but opposite optical rotations and recemize slowly at room temperature
(b) The two structures are enantiomers of each other. They racemize too rapidly at room temperature for their optical rotations to be measured
(c) The two structures are diastereomers of each other. Their interconversion is called mutarotation
(d) The two structures are diastereomers of each other. Their interconversion does not require breaking and making bonds, only a change in conformation

27. The configurations of the chirality centres in D-threose (shown) are :

CHO
HO — H
H — OH
CH_2OH

(a) 2R, 3R (b) 2R, 3S (c) 2S, 3R (d) 2S, 3S

28. Rapid interconversion of α-D-glucose and β-D-glucose in solution is known as :
(a) racemization (b) asymmetric induction
(c) fluxional isomerization (d) mutarotation

29. Identify the correct set of stereochemical relationships amongst the following monosaccharides I-IV.

(a) I and II are anomers ; III and IV are epimers
(b) I and III are epimers ; II and IV are anomers
(c) I and II are epimers ; III and IV are anomers
(d) I and III are anomers ; I and II are epimers

30. What is the structure of L-glucose ?

(d) None of these

31. What is the structure of L-glyceraldehyde?

(a) H – C = O (top), HO – CH_2 (left), OH (right), H (bottom)

(b) H (top), HO (left), CH_2OH (right), CH = O (bottom)

(c) CH_2 – OH (top), HO (left), H (right), H – C = O (bottom)

(d) Both (a) and (b)

32. HC – OH
‖
C – OH
HO —— H
H —— OH
H —— OH
CH_2OH

, the given is enol form of :

(a) D-glucose (b) D-mannose (c) D-fructose (d) All of these

33. D-glucose $\overset{HO^-}{\rightleftharpoons}$ A + B; A and B are :

(a) D-mannose & D-mannitol (b) D-mannose & D-Fructose

(c) D-Allose & D-Altrose (d) D-Glucose & D-Idose

34. Stereoisomers of aldoheptose is (a) and stereoisomers of ketoheptose is (b). Ratio of a/b is :

(a) $\frac{1}{2}$ (b) $\frac{2}{1}$ (c) $\frac{4}{1}$ (d) $\frac{1}{4}$

35. D-Glucose $\xrightarrow[\Delta]{HNO_3}$ (A); Product (A) is :

(a) D-Gluconic acid (b) D-Glucitol (c) D-Fructose (d) D-Glucaric acid

36. D-glucose & D-fructose can be differentiated by :

(a) Fehling solution (b) Tollens reagent (c) Benedict test (d) Br_2/H_2O

37. D-Glucose exist in x different forms. The value of x (stereoisomer) is :

(a) 2 (b) 3 (c) 4 (d) 5

38. D-Mannose $\overset{HO^-}{\rightleftharpoons}$ D-Glucose $\overset{HO^-}{\rightleftharpoons}$ (A) ;

Product (A) of above reaction is

(a) D-glucose (b) D-fructose (c) D-talose (d) D-idose

39. Which of the molecules below will react with Ag^+ ?

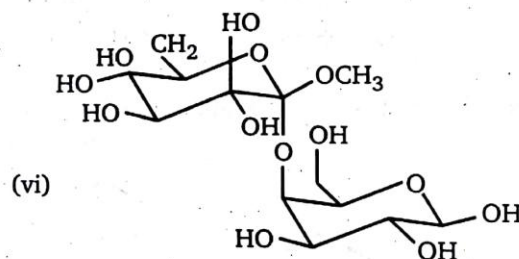
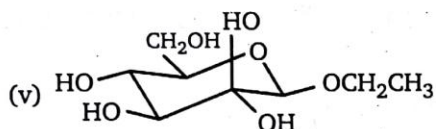
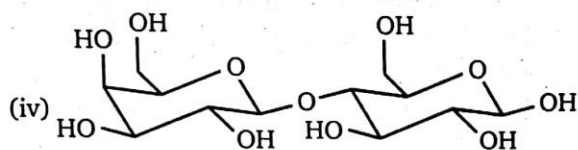
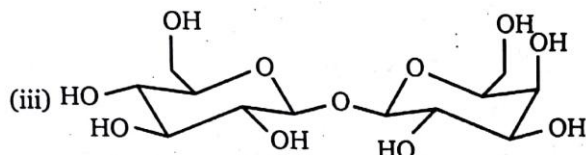
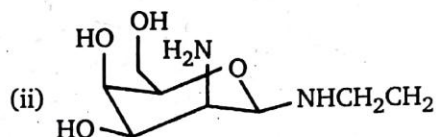
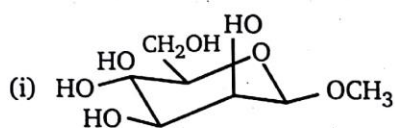
(i) [structure: methyl glycoside; labels: HO, CH_2OH, HO, O, HO, HO, OCH_3]

(ii) [structure; labels: HO, OH, H_2N, O, HO, $NHCH_2CH_2$]

(iii) [structure; labels: OH, OH, OH, HO, O, O, O, HO, OH, HO, OH]

(iv) [structure; labels: HO, OH, OH, O, O, O, OH, HO, OH, HO, OH]

(v) [structure; labels: CH_2OH, HO, O, HO, HO, OCH_2CH_3, OH]

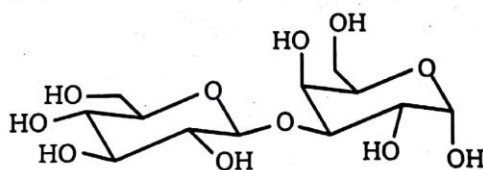
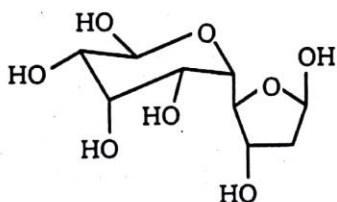
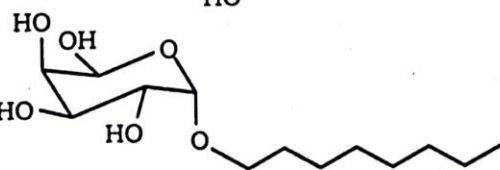
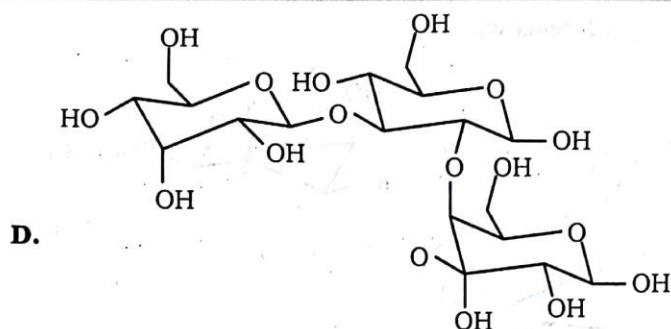
(vi) [structure; labels: HO, CH_2, HO, O, HO, OCH_3, HO, OH, O, OH, O, OH, HO, OH]

(a) (i), (iii) and (v) (b) (ii) and (iv) (c) (iv) and (vi) (d) (i), (ii), (iii) and (vi)

40. **A.** [structure; labels: HO, OH, HO, O, O, HO, O, HO, OH, HO, OH]

B. [structure; labels: HO, O, HO, OH, O, HO, HO, HO]

C. [structure; labels: HO, OH, O, HO, HO, O]

D.

OH OH
HO O HO O O
OH OH
OH O OH
O O
OH
OH OH

Which of the compounds (A-D) depicted above is NOT a hemiacetal linkage ?

(a) Compound A (b) Compound B (c) Compound C (d) Compound D

(e) None of the above (they are all hemiacetals)

41. Which of the following Fischer projection formula is same as D-Glyceraldehyde ?

(a) CH_2OH (top), OH (left), CHO (right), H (bottom)

(b) CH_2OH (top), H (left), OH (right), CHO (bottom)

(c) CHO (top), OH (left), CH_2OH (right), H (bottom)

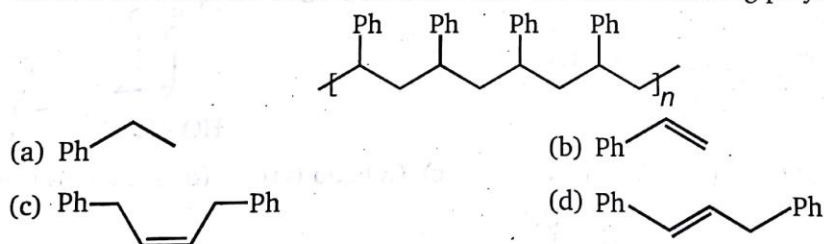
(d) CHO (top), H (left), CH_2OH (right), HO (bottom)

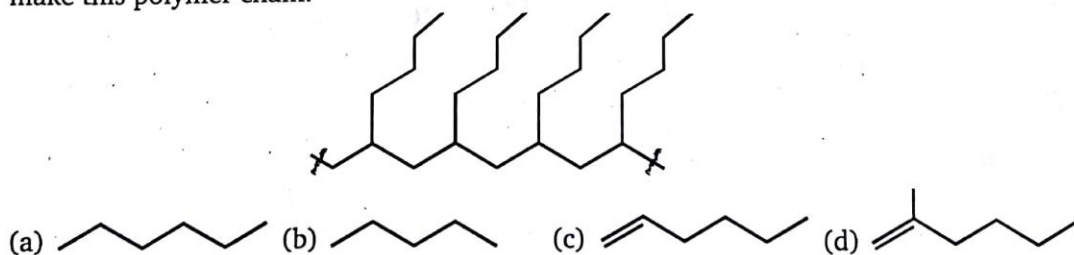
42. What is the structure of the monomer from which the following polymer was made ?

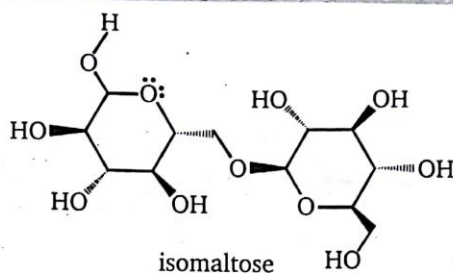
Ph Ph Ph Ph

[ ]$_n$

(a) Ph (b) Ph

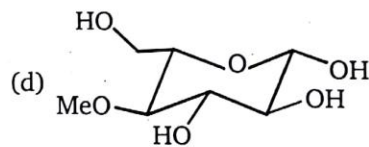
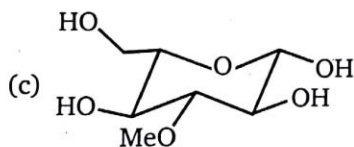
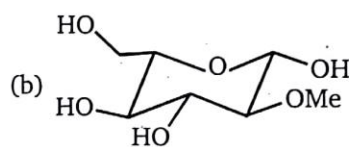
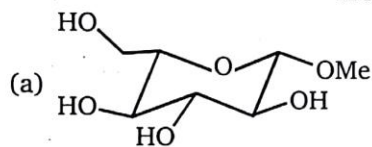
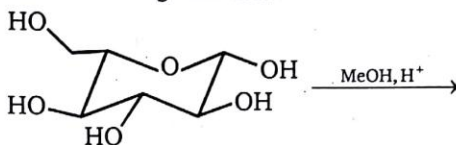
(c) Ph—Ph (d) Ph Ph

43. The following structure represents a subunit of a hydrocarbon polymer that may be prepared by a radical polymerization method. Identify the monomer that has been polymerized to make this polymer chain.

(a) (b) (c) (d)

44. Choose the answer that has correctly identified the number of acetals and hemiacetals in isomaltose.

isomaltose

	Acetal	Hemiacetal		Acetal	Hemiacetal
(a)	0	0	(b)	1	0
(c)	0	1	(d)	1	1

45. Predict the product of the following reaction.

$\xrightarrow{\text{MeOH, H}^+}$

(a) (b) (c) (d)

46 Which reagent/s can be used to distinguish glucose and fructose ?

(I) Bromine water (II) Tollen's reagent (III) Schiff's reagent

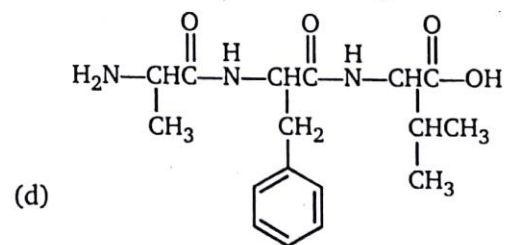
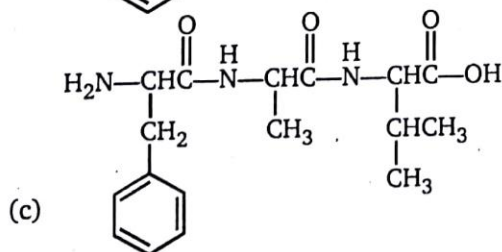
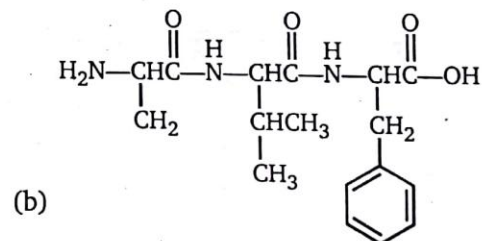
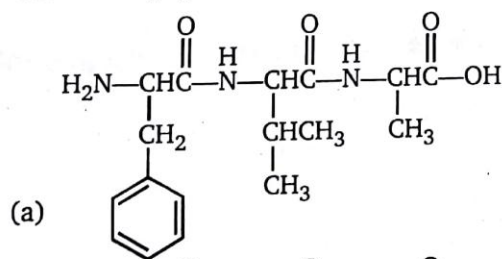
(a) (I), (II) and (III) (b) (II) and (III) (c) Only (I) (d) Only (III)

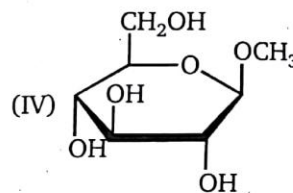
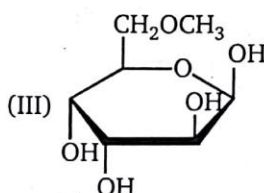
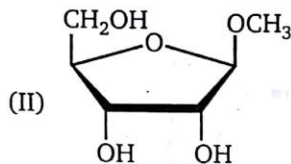
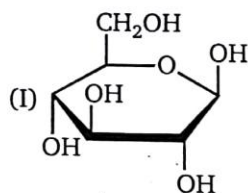
47. Choose the peptide that matches the abbreviation Phe-Val-Ala.

(a) $H_2N-CH(CH_2C_6H_5)-C(=O)-NH-CH(CHCH_3CH_3)-C(=O)-NH-CH(CH_3)-C(=O)-OH$

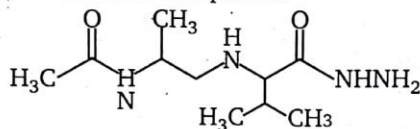
(b) $H_2N-CH(CH_2)-C(=O)-NH-CH(CHCH_3CH_3)-C(=O)-NH-CH(CH_2C_6H_5)-C(=O)-OH$

(c) $H_2N-CH(CH_2C_6H_5)-C(=O)-NH-CH(CH_3)-C(=O)-NH-CH(CHCH_3CH_3)-C(=O)-OH$

(d) $H_2N-CH(CH_3)-C(=O)-NH-CH(CH_2C_6H_5)-C(=O)-NH-CH(CHCH_3CH_3)-C(=O)-OH$

48. Which of the following carbohydrate(s) would not undergo mutarotation in aqueous solution?

(a) II only (b) I, III and IV only (c) II and IV only (d) I and III only

49. The number of peptide bonds in the compound.

O CH_3 H O
H_3C — C(=O) — NH — CH(CH_3) — CH_2 — NH — CH(CH(CH_3)$_2$) — C(=O) — $NHNH_2$
H_3C CH_3

(a) 1 (b) 2 (c) 3 (d) 4

50. Serine ($HOCH_2CH(NH_2)COOH$) is an essential amino acid. The correct Fisher projection of serine is

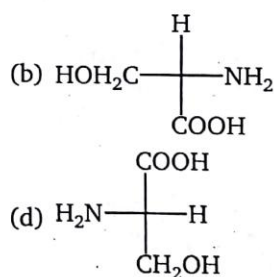
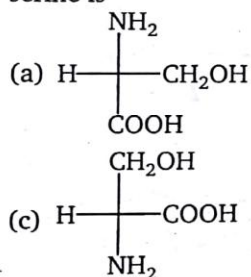
(a)
NH_2
H — | — CH_2OH
COOH

(b)
H
HOH_2C — | — NH_2
COOH

(c)
CH_2OH
H — | — COOH
NH_2

(d)
COOH
H_2N — | — H
CH_2OH

ANSWERS — LEVEL 1

1.	(b)	**2.**	(a)	**3.**	(b)	**4.**	(b)	**5.**	(c)	**6.**	(c)	**7.**	(d)	**8.**	(c)
9.	(b)	**10.**	(c)	**11.**	(b)	**12.**	(c)	**13.**	(a)	**14.**	(d)	**15.**	(a)	**16.**	(d)
17.	(c)	**18.**	(b)	**19.**	(b)	**20.**	(a)	**21.**	(b)	**22.**	(a)	**23.**	(b)	**24.**	(a)
25.	(c)	**26.**	(c)	**27.**	(c)	**28.**	(d)	**29.**	(d)	**30.**	(a)	**31.**	(d)	**32.**	(d)
33.	(b)	**34.**	(b)	**35.**	(d)	**36.**	(d)	**37.**	(b)	**38.**	(b)	**39.**	(c)	**40.**	(e)
41.	(c)	**42.**	(b)	**43.**	(c)	**44.**	(d)	**45.**	(a)	**46.**	(c)	**47.**	(a)	**48.**	(c)
49.	(a)	**50.**	(d)												

LEVEL-2

1. Match the Column (I) and Column (II). (Matrix)

	Column (I)		Column (II)
	Molecule		**Configuration**
(a)	CHO H —— OH CH_2OH	**(p)**	R- (Rectus)
(b)	CHO HO —— H CH_2OH	**(q)**	S- (Sinister)
(c)	NH_2 H —— CO_2H CH_3	**(r)**	D
(d)	NH_2 H —— CH_3 CO_2H	**(s)**	L

2. Comprehension

A
CH_2OH
OH B O
C OH F
D E OH
OH

One cyclic acetal form of D-galactose is shown above.

A. Which atom is the anomeric carbon ?

(a) Atom A (b) Atom B (c) Atom C (d) Atom D
(e) Atom E (f) Atom F

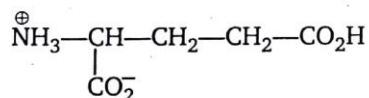
B. Which name most completely describes this cyclic acetal form ?

(a) α-D-Galactofuranose (b) β -P- Galactofuranose
(c) α-D- Galactopyranose (d) β -D- Galactopyranose

3. How many compound which is given below is isomer of *D*-Glucose ?

D-Mannose, *D*-Fructose, *D*-Gulose, *D*-Idose, *D*-Galactose, *D*-Arabinose, *D*-Ribose.

4. How many acidic group is present in given amino acid ?

$$\overset{\oplus}{N}H_3-\underset{\underset{CO_2^-}{|}}{CH}-CH_2-CH_2-CO_2H$$

ANSWERS — LEVEL 2

1. a – p, r; b – q, s; c – q, s; d – p, r

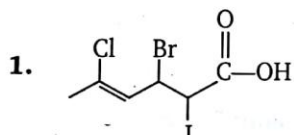
2. A – f; B – c

3. 5

4. 2

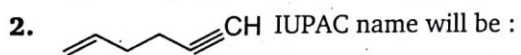
15 IUPAC NAME

LEVEL-1

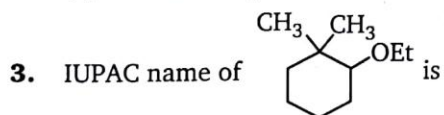
1. Cl Br O ‖ C—OH I

Total number of substituent present in the above compound :

(a) 1 (b) 2

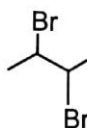
(c) 3 (d) 4

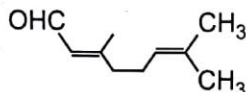
2. CH IUPAC name will be :

(a) Hex-5-en-1-yne (b) Hex-1-en-5-yne

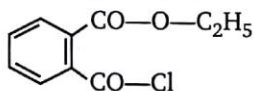
(c) Hex-6-en-1-yne (d) Hex-1-en-6-yne

3. IUPAC name of CH_3 CH_3 OEt is

(a) 1-Ethoxy-2, 2-dimethylcyclohexane (b) 2-ethoxy-1, 1-dimethyl cyclohexane

(c) 1, 1-Dimethyl-2-ethoxycyclohexane (d) 2-methyl-1, 1-ethoxy cyclohexane

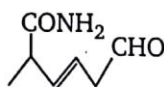
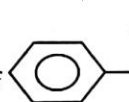
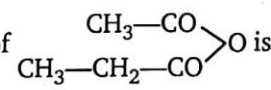
4. How many secondary carbon and hydrogen atoms are present in the molecule given below respectively ?

(a) 2, 3 (b) 2, 2 (c) 3, 3 (d) 2, 0

5. Which IUPAC name is correct for the given compound ?

(a) 3, 7-dimethylocta-2, 6-dienal (b) 2, 6-dimethyloct-2, 6-dienal-8
(c) 7-formyl-2, 6-dimethylhept-2, 6-diene (d) 7-aldo-2,6-dimethylhept-2, 6-diene

6. Write the IUPAC name of the following compound :

(a) ethyl-2-(chlorocarbonyl) benzoate (b) ethyl-2-(chlorocarbonyl) hexanoate
(c) 2-(thoxycarbonyl) benzoyl chloride (d) None of these

7. The IUPAC name of the compound $\underset{H_3C}{\overset{Cl}{}}\!\!>C=C<\!\!\underset{I}{\overset{CH_2CH_3}{}}$ is :

(a) *trans*-2-chloro-3-iodo-2-pentene (b) *cis*-2-chloro-3-iodo-2-pentene
(c) *trans*-3-iodo-4-chloro-3-pentene (d) *cis*-3-iodo-4-chloro-3-pentene

8. The IUPAC name of the compound is :

(a) 2-methyl-6-oxohex-3-enamide (b) 6-keto-2-methyl hexanamide
(c) 2-carbamoylhexanal (d) 2-carbamoylhex-3-enal

9. The IUPAC name of [structure] is:

(a) 1-Bromo-2-chloro-3-fluoro-6-iodo benzene
(b) 2-Bromo-1-chloro-5-fluoro-3-iodo benzene
(c) 4-Bromo-2-chloro-5-iodo-1-fluoro benzene
(d) 2-Bromo-3-chloro-1-iodo-5-fluoro benzene

10. The IUPAC name of

is:

(a) Methyl 2-ethylbutanoate
(b) 1-methoxy-2-ethylbutanone
(c) 3-Methoxycarbonylpentane
(d) 1-methoxy-2-ethylbutanal

11. The IUPAC name of $CH_3-CH=CH-\overset{\overset{O}{||}}{C}-OH$ is:

(a) But-1-en-4-oic acid
(b) 1-hydroxybut-2-en-1-one
(c) But-2-en-1-oic acid
(d) But-2-en-4-oic acid

12. The IUPAC name of $CH_3-CH=\underset{}{\overset{\overset{OCH_3}{|}}{C}}-CH_3$ is:

(a) 1-Methoxy-1-methylpropene
(b) 2-Methoxybut-2-ene
(c) dimethylpropeneether
(d) none of these

13. The IUPAC name of $CH_2=\overset{\overset{Me}{|}}{C}-\overset{\overset{O}{||}}{C}-OC_2H_5$ is:

(a) Ethyl 2-methylprop-2-enoate
(b) Ethyl 2-methylprop-1-enoate
(c) 1-Ethoxy-2-methylprop-2-enone
(d) 1-Ethoxy-2-methylprop-2-enal

14. The IUPAC name of $CH_3-\overset{\overset{CH_3}{|}}{CH}-\overset{\overset{CH_3}{|}}{CH}-CH_2NH_2$ is:

(a) 2, 3-Dimethylbutan-4-amine
(b) 2, 4-Dimethylbutan-1-amine
(c) 2,4-Dimethylbutan-4-amine
(d) 2, 3-Dimethylbutan-1-amine

15. The IUPAC name of $CH_3-\overset{\overset{O}{||}}{C}-\underset{\underset{C_2H_5}{|}}{CH}-\underset{\underset{CH_3}{|}}{CH}-CH_3$ is:

(a) 3-(Methylethyl) pentan-2-one
(b) 3-(Methylethyl)pentan-4-one
(c) 3-Ethyl-4-methylpentan-2-one
(d) 3-Ethyl-2-methylpentan-4-one

16. The IUPAC name of $CH_3-\underset{\underset{CH_3}{|}}{CH}-CH_2-\overset{\overset{O}{||}}{C}-Br$ is:

(a) 2-Methylbutanoyl bromide
(b) 2-Methylbutan-4-oyl bromide
(c) 1-Bromo-3-Methylbutanone
(d) 3-Methylbutanoyl bromide

17. The IUPAC name of $CH_3-\underset{\underset{C_6H_5}{|}}{CH}-CH_2-OH$ is:

(a) 2-Phenylpropan-1-ol (b) 2-Phenylpropan-3-ol

(c) 1-(2-Hydroxy-1-methylethyl) benzene (d) 1-((Hydroxymethyl)ethyl) benzene

18. The IUPAC name of $CH_3-\overset{\overset{CH_3}{|}}{\underset{\underset{CH_3}{|}}{C}}-\underset{\underset{CH_3}{|}}{CH}-\underset{\underset{I}{|}}{CH}-CH_2-CH_3$ is:

(a) 3-Iodo-4,5,5-trimethylhexane (b) 4-Iodo-1, 1, 3-trimethylhexane

(c) 4-Iodo-2, 2-dimethylheptane (d) 4-Iodo-2, 2, 3-trimethylhexane

19. The IUPAC name of $CH_3-CH_2-\underset{\underset{Cl}{|}}{CH}-\underset{\underset{CH_3}{|}}{CH}-\overset{\overset{CH_3}{|}}{\underset{\underset{OH}{|}}{C}}-CH_3$ is:

(a) 4-Chloro-2, 3-dimethylhexane-2-ol (b) 4-Chloro-2-hydroxy-2, 3-dimethylhexane

(c) 4-Chloro-1, 1, 2-trimethylpentan-2-ol (d) 3-Chloro-2, 3-dimethylhexane-2-ol

20. The IUPAC name of $C_6H_5-\overset{\overset{CH_3}{|}}{CH}-CHO$ is:

(a) 2-Phenylpropan-3-al (b) Formylethylbenzene

(c) 2-Phenylpropanal (d) Ethylformylbenzene

21. The IUPAC name of $CH_3-\overset{\overset{O}{||}}{C}-CH(CH_3)_2$ is:

(a) 2-Methylbutan-3-one (b) 3-Methylbutan-2-al

(c) 2-Methylbutan-3-al (d) 3-Methylbutan-2-one

22. The IUPAC name of $\begin{matrix} CH_3-CO \\ CH_3-CH_2-CO \end{matrix}\!\!>O$ is:

(a) Ethanoic propanoic anhydride (b) Propanoic ethanoic anhydride

(c) 1-Ethanoyloxypropanone (d) 3-Ethanoyloxypropan-3-one

23. The IUPAC name of $CH_3-\underset{\underset{OH}{|}}{CH}-\underset{\underset{C_2H_5}{|}}{CH}-CH_2-OH$ is:

(a) 3-Ethylbutane-2, 4-diol (b) 2-Ethylbutane-1, 3-diol

(c) 3-Ethylbutane-1, 3-diol (d) 2-Ethyl-1-methylpropane-1, 3-diol

24. The IUPAC name of $CH_3-\underset{\underset{O}{\|}}{C}-\underset{\underset{O}{\|}}{C}-CH_3$ is:

(a) Butane-2, 3-dial (b) Butane-1, 3-dione

(c) Butane-2, 3-dione (d) 1, 2-dimethylethanedione

25. The IUPAC name of $CH_2=CH-CH=CH_2$ is:

(a) Butane (b) Buta-1, 3-diene (c) Butane-1, 3-diene (d) none of these

26. The IUPAC name of $\underset{\underset{COOH}{|}}{CH_2}-CH_2-\underset{\underset{COOH}{|}}{CH_2}$ is:

(a) Pentane-1, 5-dioic acid (b) Pentane-1, 5-dicarboxylic acid

(c) Propane-1, 3-dioic acid (d) none of these

27. The IUPAC name of $\underset{\underset{CHO}{|}}{CH_2}-CH=CH-CHO$ is:

(a) propene-1, 3-dial (b) Propene-1, 3-dicarbaldehyde

(c) Pent-3-ene-1, 5-dial (d) Pent-2-ene-1, 5-dial

28. The IUPAC name of $\underset{\underset{CH_2-CN}{|}}{CH_2}-CN$ is:

(a) Butane-1, 4-dicarbonitrile (b) Ethane-1, 2-dicarbonitrile

(c) Ethane-1, 2-dinitrile (d) Butane-1, 4-dinitrile

29. The IUPAC name of $\underset{\underset{NH_2}{|}}{CH_2}-\underset{\underset{CH_3}{|}}{CH}-CH_2-\underset{\underset{NH_2}{|}}{CH_2}$ is:

(a) 2-Methylbutane-1, 4-diamine

(b) 3-Methylbutane-1, 4-diamine

(c) 3-(Aminomethyl)butanamine

(d) 2-(Aminomethyl)butan-4-amine

30. The IUPAC name of $\underset{\underset{Cl}{|}}{CH_2}-\overset{\overset{CH_2Cl}{|}}{CH}-\underset{\underset{Cl}{|}}{CH_2}$ is:

(a) Tris(chloromethyl) methane

(b) 1, 3-Dichloro-2 (chloromethyl) propane

(c) 1-Chlorobis(chloromethyl) ethane

(d) none of these

31. The IUPAC name of $CH_3-\underset{|}{\underset{OH}{CH}}-\underset{CH_3}{CH}-\underset{OH}{CH}-\overset{CH_3}{\underset{CH_3}{C}}-CH_3$ is:

(a) 3, 5, 5-Trimethylhexane-2, 4-diol (b) 2, 2, 4-Trimethylhexane-3, 5-diol

(c) 1, 2, 4, 4-Tetramethylpantane-1, 3-diol (d) 2, 2, 4, 5-Tetramethylpantane-3, 5-diol

32. The IUPAC name of $HOOC-CH=CH-COOH$ is:

(a) But-2-ene-1, 4-dicarboxylic acid (b) But-2-ene-1, 4-dioic acid

(c) Ethene dicarboxylic acid (d) Ethene dioic acid

33. The IUPAC name of $CH_3-\overset{OCH_3}{CH}-CHO$ is:

(a) 1-Formyl-1-methoxyethane (b) 2-Methoxypropan-3-one

(c) 2-Methoxypropanal (d) 2-Methoxypropan-3-al

34. The IUPAC name of $CH_2=\overset{CH_3}{C}-COOCH_3$ is:

(a) Methyl-2-methylprop-1-en-3-oate (b) 2-Methoxycarbonylpropene

(c) 2-Methoxycarbonylprop-2-ene (d) Methyl-2-methylprop-2-enoate

35. The IUPAC name of $CH_3-CH=CH-COOH$ is:

(a) But-2-ene-1-oic acid (b) But-1-ene-1-oic acid

(c) But-2-ene-1-carboxylic acid (d) Propene-1-carboxylic acid

36. The IUPAC name of $CH_3-\overset{OH}{CH}-COOH$ is:

(a) 2-Hydroxypropanoic acid (b) 1-Hydroxypropanoic acid

(c) 1-Hydroxyethane carboxylic acid (d) 1-Hydroxyethanoic acid

37. The IUPAC name of $\begin{array}{c} HO-CH-COOH \\ | \\ HO-CH-COOH \end{array}$ is:

(a) 2, 3-Dihydroxybutane-1, 4-carboxylic acid

(b) 2, 3-Dihydroxybutane-1, 4-dioic acid

(c) 1, 2-Dihydroxyethane dicarboxylic acid

(d) none of these

38. The IUPAC name of $CH_3-\underset{\underset{CH_3}{|}}{CH}-\underset{\underset{O}{||}}{C}-COOH$ is:

(a) 3-Methyl-2-oxobutanecarboxylic acid (b) 2-Methyl-3-oxobutan-4-oic acid

(c) 3-Methyl-2-oxobutanoic acid (d) 3-Methyl-1,2-dioxobutanoic acid

39. The IUPAC name of $NC-CH_2-CH_2-COOH$ is:

(a) 3-Carboxy propanenitrile (b) 4-Cyanobutanoic acid

(c) 2-Cyanoethane Carboxylic acid (d) 3-Cyanopropanoic acid

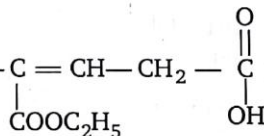
40. The IUPAC name of $CH_2COOH-C(OH)(COOH)-CH_2COOH$ is:

(a) 3-Carboxy-3-hydroxypentanedicarboxylic acid

(b) 2-Hydroxypropane-1, 2, 3-tricarboxylic acid

(c) 2-Hydroxypropane-1, 2, 3-trioic acid

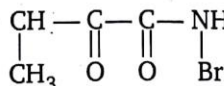
(d) 3-Hydroxypropane-1, 2, 3-tricarboxylic acid

41. The IUPAC name of $CH_3-\underset{\underset{COOC_2H_5}{|}}{C}=CH-CH_2-\underset{\underset{OH}{|}}{\overset{\overset{O}{||}}{C}}$ is:

(a) 4-ethoxycarbonylpent-3-enoic acid

(b) 4-ethanoyloxypent-3-enoic acid

(c) 3-ethoxycarbonylbut-2-enecarboxylic acid

(d) 3-ethoxycarbonylpent-3-enoic acid

42. The IUPAC name of $CH_3-\underset{\underset{CH_3}{|}}{CH}-\underset{\underset{O}{||}}{C}-\underset{\underset{O}{||}}{C}-\underset{\underset{Br}{|}}{NH}$ is:

(a) (*N*-Bromo)-2-keto-3-methylbutanamide

(b) (*N*-Bromo)-2-keto-4-methylbutanamide

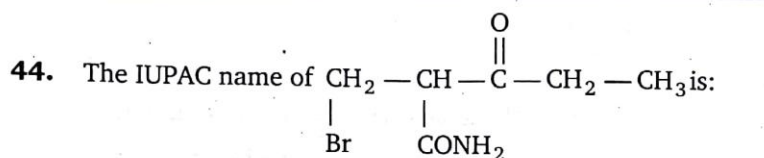
(c) (*N*-Bromo)-1, 2-diketo-3-methylbutanamine carboxamide

(d) (*N*-Bromo)-1-keto-2-methylpropane

43. The IUPAC name of $\underset{\underset{Cl}{|}}{CH_2}-\underset{\underset{CH_3}{|}}{C}=CH-CH_2OH$ is:

(a) 4-Chloro-3-methylbut-2-en-1-ol (b) 1-Chloro-2-methylbut-2-en-4-ol

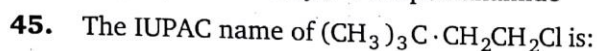
(c) 4-Chloro-1-hydroxy-3-methylbut-2-ene (d) 1-Chloro-4-hydroxy-2-methylbut-2-ene

44. The IUPAC name of $\underset{\underset{Br}{|}}{CH_2}-\underset{\underset{CONH_2}{|}}{CH}-\overset{\overset{O}{||}}{C}-CH_2-CH_3$ is:

(a) 2-(Bromomethyl)-3-oxopentane carboxamide

(b) 1-Bromo-2-carbamoylpentan-3-one

(c) 5-Bromo-4-carbamoylpentan-3-one

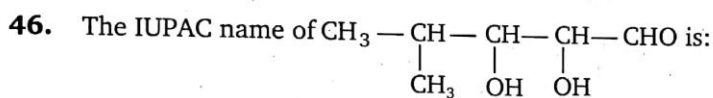
(d) 2-(Bromomethyl)-3-oxopentanamide

45. The IUPAC name of $(CH_3)_3C\cdot CH_2CH_2Cl$ is:

(a) 2, 2-Dimethyl-4-chloro butane

(b) 1-Chloro-3, 3-dimethylbutane

(c) 4-Chloro-2, 2-dimethyl butane

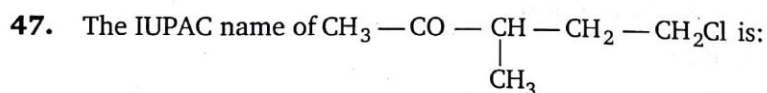
(d) none of these

46. The IUPAC name of $CH_3-\underset{\underset{CH_3}{|}}{CH}-\underset{\underset{OH}{|}}{CH}-\underset{\underset{OH}{|}}{CH}-CHO$ is:

(a) 2, 3-Dihydroxy-4-methylpentanal

(b) 1-oxo-2, 3-Dihydroxy-4-methylpentane

(c) 2,3-Dihydroxy-4-methylpentanone

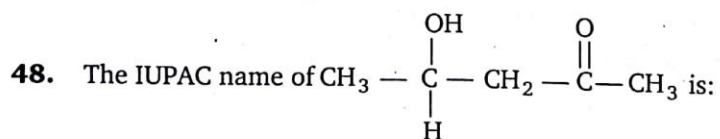
(d) 1, 2-Dihydroxy-3-methylbutanecarbaldehyde

47. The IUPAC name of $CH_3-CO-\underset{\underset{CH_3}{|}}{CH}-CH_2-CH_2Cl$ is:

(a) 1-Chloro-3-methylpentan-4-one

(b) 1-Chloro-2-(oxoethylbutane)

(c) 5-Chloro-3-methylpentan-2-one

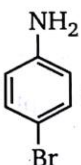
(d) 3-(2-Chloroethyl)butan-2-one

48. The IUPAC name of $CH_3-\underset{\underset{H}{|}}{\overset{\overset{OH}{|}}{C}}-CH_2-\overset{\overset{O}{||}}{C}-CH_3$ is:

(a) 2-Hydroxypentan-4-one

(b) 4-Hydroxypentan-2-one

(c) 4-oxopentan-2-ol

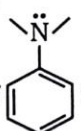
(d) 2-oxopentan-4-ol

49. The IUPAC name of $CH_3-\underset{\displaystyle Cl}{\underset{|}{C}H}-\underset{\displaystyle Br}{\underset{|}{C}H}-\underset{\displaystyle OH}{\underset{|}{C}H}-CH_3$ is:

(a) 3-Bromo-4-chloropentan-2-ol

(b) 3-Bromo-2-chloro-4-hydroxypentane

(c) 3-Bromo-2-chloropentane-4-ol

(d) none of these

50. The IUPAC name of $CH_3-CH_2-\overset{\displaystyle Br}{\overset{|}{\underset{\displaystyle OH}{\underset{|}{C}}}}-\overset{\displaystyle Cl}{\overset{|}{C}H}-CH_2-Cl$ is:

(a) 3-Bromo-4, 5-dichloropentan-3-ol

(b) 3-Bromo-1, 2-dichloro-3-hydroxypentane

(c) 3-Bromo-1, 2-dichloropentan-3-ol

(d) 3-Bromo-4, 5-dichloro-3-hydroxypentane

51. The IUPAC name of $CH_3-\underset{\displaystyle OH}{\underset{|}{C}H}-CH_2-O-C_2H_5$ is:

(a) 1-Ethoxypropan-2-ol

(b) 3-Ethoxypropan-2-ol

(c) 1-Ethoxy-2-hydroxypropane

(d) none of these

52. The IUPAC name of [benzene ring with NH_2 and Br at para positions] is:

(a) 4-Bromo benzenamine

(b) 4-Amino-1-bromobenzene

(c) 4-Bromo benzenamide

(d) 1-Bromo benzencarboxamide

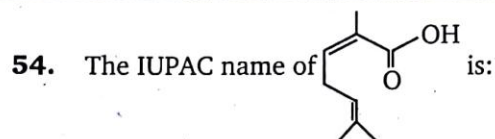
53. The IUPAC name of [benzene ring with $N(CH_3)_2$] is:

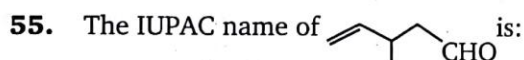
(a) *N, N*-Dimethyl aminobenzene

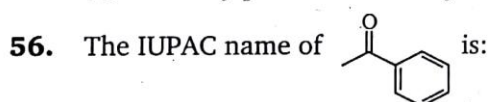
(b) *N, N*-Dimethyl benzenamine

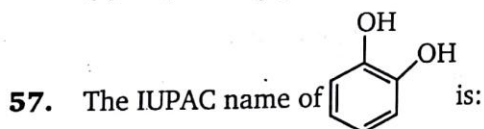
(c) (a) and (b) both are correct

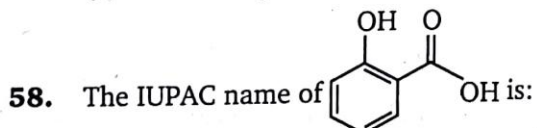
(d) none of these

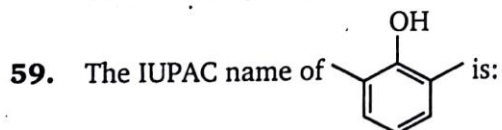
54. The IUPAC name of [structure] is:

(a) 2, 6-Dimethylhepta-2, 5-dienoic acid
(b) 3, 7-Dimethylhepta-2, 5-dienoic acid
(c) 1-Hydroxy-2, 6-dimethylhepta-2, 5-dienone
(d) none of these

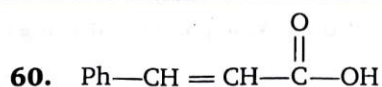
55. The IUPAC name of [structure] CHO is:

(a) 3-Methylpent-1-en-4-al
(b) 3-Methylpent-4-enal
(c) 3-Methylpent-4-carbaldehyde
(d) 3-Methyl-5-oxopent-1-ene

56. The IUPAC name of [structure] is:

(a) 2-Phenyl ethanone
(b) 1-Phenyl ethanone
(c) 1-(Oxoethyl)benzene
(d) 1-(Ethyaloxo)-benzene

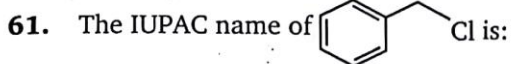
57. The IUPAC name of [structure: OH, OH] is:

(a) 2-Hydroxybenzenol
(b) 1, 2-Dihydroxybenzene
(c) Benzene-1, 2-diol
(d) 2-Hydroxyphenol

58. The IUPAC name of [structure: OH, O, OH] is:

(a) 2-Carboxyphenol
(b) 2-Hydroxybenzoic acid
(c) 1-Carboxy-2-hydroxybenzene
(d) 2-Carboxy-1-hydroxybenzene

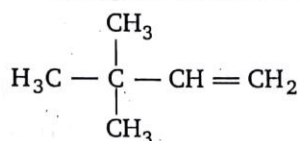
59. The IUPAC name of [structure: OH] is:

(a) 1,3-Dimethyl phenol
(b) 1-Hydroxy-2-6-dimethyl benzene
(c) 2, 6-Dimethyl benzenol
(d) 2-Hydroxy-1-3-dimethylbenzene

60. $Ph—CH = CH—\overset{O}{\overset{||}{C}}—OH$

The IUPAC name is :

(a) 3-phenyl prop-2-enoic acid
(b) 3-phenol prop-1-enoic acid
(c) 3-carboxy-prop-1-ene benzene
(d) but-2-enoic acid

61. The IUPAC name of $C_6H_5CH_2Cl$ (benzene ring–CH_2–Cl) is:

(a) Chloromethylbenzene
(b) Chlorophenylmethane
(c) (a) and (b) both
(d) none of these

62. The IUPAC name of the compound having the formula is :

$$H_3C - \underset{CH_3}{\overset{CH_3}{\underset{|}{\overset{|}{C}}}} - CH = CH_2$$

(a) 3, 3, 3-Trimethylprop-1-ene
(b) 1, 1, 1-Trimethylprop-2-ene
(c) 3, 3-Dimethylbut-1-ene
(d) 2, 2-Dimethylbut-3-ene

63. The IUPAC name of the compound $CH_2 = CH — CH(CH_3)_2$ is :

(a) 1, 1-Dimethylprop-2-ene
(b) 3-Methylbut-1-ene
(c) 2-Vinyl propane
(d) none of these

64. The number of sigma and pi-bonds in 1-butene 3-yne are :

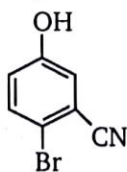
(a) 5 sigma and 5 pi
(b) 7 sigma and 3 pi
(c) 8 sigma and 2 pi
(d) 6 sigma and 4 pi

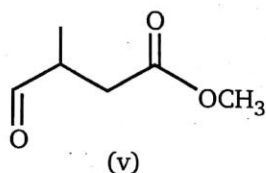
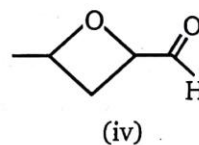
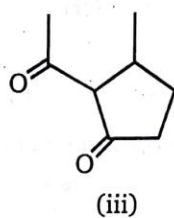
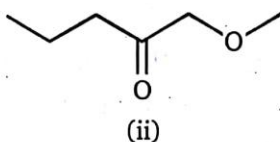
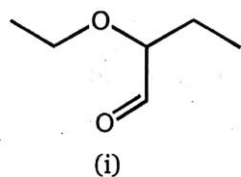
65. The IUPAC name of C_6H_5COCl is :

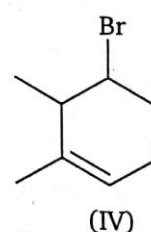
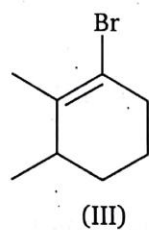
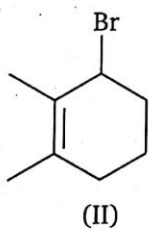
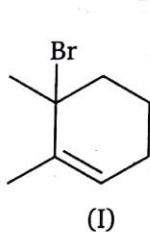
(a) Benzoyl Chloride
(b) Benzene chloro ketone
(c) Benzene carbonyl chloride
(d) Chloro phenyl ketone

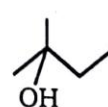
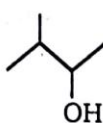
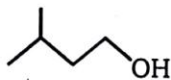
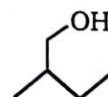
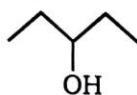
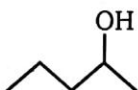
66. The IUPAC name of the following compound is :

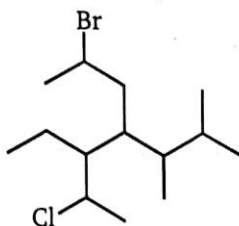
(Benzene ring with OH, CN and Br substituents)

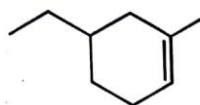
OH
CN
Br

(a) 4-Bromo-3-cyanophenol
(b) 2-Bromo-5-hydroxybenzonitrile
(c) 2-Cyano-4-hydroxybromobenzene
(d) 6-Bromo-3-hydroxybenzonitrile

67. Many organic compounds contain more than one functional group. Which of the following is both an aldehyde and an ether ?

(a) (i) only
(b) (i) and (iv)
(c) (ii) and (v)
(d) (iii) and (iv)

68. What is the sum of positions assigned to bromine while numbering the Parent Chain in the below compounds ?

(a) 13
(b) 14
(c) 15
(d) 16

69. How many number of compounds, which have same IUPAC name ?

(a) 0
(b) 1
(c) 2
(d) 3

70. How many total number of substituents are present in the following compound ?

(a) 3 (b) 4 (c) 5 (d) 6

71.

Correct IUPAC name :

(a) 1-methyl-3-ethylcyclohexene
(b) 5-ethyl-1-methylcyclohexene
(c) 2-ethyl-4-methylcyclohexene
(d) 3-ethyl-1-methylcyclohexene

ANSWERS — LEVEL 1

1.	(c)	**2.**	(b)	**3.**	(b)	**4.**	(b)	**5.**	(a)	**6.**	(a)	**7.**	(a)	**8.**	(a)
9.	(b)	**10.**	(a)	**11.**	(c)	**12.**	(b)	**13.**	(a)	**14.**	(d)	**15.**	(c)	**16.**	(d)
17.	(a)	**18.**	(d)	**19.**	(a)	**20.**	(c)	**21.**	(d)	**22.**	(a)	**23.**	(b)	**24.**	(c)
25.	(b)	**26.**	(a)	**27.**	(d)	**28.**	(d)	**29.**	(a)	**30.**	(b)	**31.**	(a)	**32.**	(b)
33.	(c)	**34.**	(d)	**35.**	(a)	**36.**	(a)	**37.**	(b)	**38.**	(c)	**39.**	(d)	**40.**	(b)
41.	(a)	**42.**	(a)	**43.**	(a)	**44.**	(d)	**45.**	(b)	**46.**	(a)	**47.**	(c)	**48.**	(b)
49.	(a)	**50.**	(c)	**51.**	(a)	**52.**	(a)	**53.**	(b)	**54.**	(a)	**55.**	(b)	**56.**	(b)
57.	(c)	**58.**	(b)	**59.**	(c)	**60.**	(a)	**61.**	(b)	**62.**	(c)	**63.**	(b)	**64.**	(b)
65.	(c)	**66.**	(b)	**67.**	(b)	**68.**	(c)	**69.**	(a)	**70.**	(c)	**71.**	(b)		

LEVEL-2

Give the IUPAC name of the following compounds

1. OH
2. OH
3. Cl, OH, Br
4. HO, Cl, Br
5. Cl, OH, Br
6. OH, Cl, Br
7. HO, Br, Cl, HO
8. Cl, Br, OH
9. OH
10. HO, Br, Cl
11. HO
12. OH, OH
13. Cl, OH
14. Br, Cl, HO, OH
15. Cl, OH
16. Cl, OH, Br
17. HO, HO, OH
18. HO, OH

19.

20.

21.

22.

23.

24.

25.

26.

27.

28.

29.

30.

31.

32. OH Cl Br Br

33. O O

34. O O

35. O O

36. O O

37. O O

38. O

39. O

40. O

41. O O

42. O O O

63. O Br Cl OH

64. O OH

65. O Br Br O OH

66. O NH Cl Br O OH

67. O O

68. O O O O

69.

70. O Cl

71. O N+ O O- O O

72. OH O=S=O O HO O

130. Give the IUPAC name of the following compounds :

(a) $CH_3-CH_2-CH(CH_3)-CH_2-CH_2-CH_2-CH_2-CH_2-CH_2-CH_2-CH_2-CH(CH_3)-CH_3$

(b) $CH_3-CH_2-CH(OH)-CH_2-CH_2-CH_2-CH_2-CH_2-CH_2-CH_2-CH_2-CH(CH_3)-CH_3$

(c) $CH_3-CH_2-CH_2-CH_2 \quad CH_2-CH_3$
$CH_3-CH_2-CH-CH-CH_3$ (the CH_2 of the first chain is bonded to the first CH, and the CH_2-CH_3 to the second CH)

(d) [cyclic structure with three CH_3 substituents]

CH_3

$CH_3 \quad CH_3$

(e) [cyclopentane ring with CH_3 substituents]

CH_3

CH_3

CH_3

CH_3

131. Give the IUPAC name of the following :

(a)
$$\begin{array}{l} \qquad\qquad\qquad\qquad\qquad\quad CH_3 \\ \qquad\qquad\qquad\qquad\qquad\quad | \\ \quad CH_3 \qquad\qquad\qquad\quad CH_2-CH-CH_3 \\ \quad | \qquad\qquad\qquad\qquad\;\; | \\ \underset{1}{CH_3}-\underset{2}{CH}-\underset{3}{CH_2}-\underset{4}{CH_2}-\underset{5}{CH}-\underset{6}{CH_2}-\underset{7}{CH_2}-\underset{8}{CH_2}-\underset{9}{CH_3} \end{array}$$

(b)
$$\begin{array}{l} \qquad\qquad\qquad\qquad\qquad\quad CH_3 \\ \qquad\qquad\qquad\qquad\quad\; 3 \quad |2 \quad 1 \\ \quad CH_3 \qquad\qquad\qquad\quad CH_2-CH-CH_3 \\ \quad | \qquad\qquad\qquad\qquad\;\; | \\ \underset{8}{CH_3}-\underset{7}{CH}-\underset{6}{CH_2}-\underset{5}{CH_2}-\underset{4}{CH}-CH_2-CH_2-CH_3 \end{array}$$

(c)
$$\begin{array}{l} \qquad\qquad\qquad\qquad\qquad\qquad\quad CH_3 \;\; CH_3 \\ \qquad\qquad\qquad\qquad\qquad\qquad\quad | \qquad\; | \\ \qquad\quad CH_3 \qquad\qquad\qquad\quad CH_2-CH-CH-CH_3 \\ \qquad\quad | \qquad\qquad\qquad\qquad\;\; | \\ \underset{1}{CH_3}-\underset{2}{CH_2}-\underset{3}{CH}-\underset{4}{CH_2}-\underset{5}{CH_2}-\underset{6}{CH}-\underset{7}{CH_2}-\underset{8}{CH_2}-\underset{9}{CH_2}-\underset{10}{CH_2}-\underset{11}{CH_3} \end{array}$$

(d)

5 6
6 1
4 5 2 1
4 3
3 2

(e)

OH
5 6
6 1
4 5 2 1
4 3
3 2

(f)

1
4
5 5 3 2
4 1 2 3

(g)

4
3 5
6
2 7
CH_3
1

(h)

CH_3 2 1 6
4 5
3
7

(i)

5 3 1
8 7 6 4 2

(j)

3 2
1
3 2 1 4 5 6 7 8 9

(k)
$$\begin{array}{l} \qquad\qquad\qquad\qquad\qquad CH_3 \\ \qquad\qquad\qquad\qquad\qquad | \\ \qquad\qquad\qquad\quad CH_3 \;\; CH-CH_3 \\ \qquad\qquad\qquad\quad | \qquad | \\ \qquad\qquad CH_3-CH-C-CH_2-CH_3 \\ \qquad\qquad\qquad\qquad\quad | \\ CH_3-CH_2-CH_2-CH_2-CH-CH_2-CH_2-CH_2-CH_3 \end{array}$$

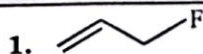
132. Match the Column :

	Column (I) Compound		Column (II) IUPAC Name
(a)	Cl, Br	**(p)**	1, 3-dibromo-2-chlorocyclopropane
(b)	Br, Cl	**(q)**	1, 2-dibromo-3-chlorocyclopropene
(c)	Br, Cl, Br	**(r)**	3-bromo-1-chlorocyclopropene
(d)	Cl, Br, Br	**(s)**	1-bromo-3-chlorocyclopropene

133. Match the Column :

	Column (I)		Column (II)
(a)	Cl, Cl, Br	**(p)**	1-butyl-4-methyl cyclohexane
(b)		**(q)**	2-bromo-1,1-dichloro cyclohexane
(c)	COOEt, CHO	**(r)**	1-Bromo-1,2-dichloro cyclohexane
(d)	Br, Cl, Cl	**(s)**	Ethyl-2-formyl cyclohexane carboxylate

SUBJECTIVE PROBLEMS

1. F

When IUPAC name of following compound is given, then double bond and substituent gets respectively
(x and y) number so the sum of $(x + y)$ will be

ANSWERS – IUPAC Name			
1.	pent-4-yn-1-ol	**2.**	pent-4-en-1-ol
3.	(5*E*)-2-bromo-3-chlorohept-5-en-1-ol	**4.**	3-bromo-2-chloro-6-ethenylcyclohexanol
5.	4-bromo-3-chloro-5-cyclopropylcyclohexanol		
6.	3-bromo-2-chloro-5-methylidenecyclohexanol		
7.	3-bromo-2-chloro-5-methylidenecyclohexane-1,4-diol		
8.	2-bromo-4-chloro-5-ethynylcyclohexanol	**9.**	cyclopenta-1,3-dien-1-ol
10.	2-bromo-5-chlorocyclopenta-2,4-dien-1-ol		
11.	cyclopenta-2,4-dien-1-ol	**12.**	dodec-10-en-4-yne-3,8-diol
13.	1-chloro-3-methylbut-3-en-2-ol	**14.**	4-bromo-2-chlorooct-6-ene-3,5-diol
15.	3-chloro-5-(1-methylethenyl)cyclopenta-1,3-dien-1-ol		
16.	2-bromo-5-chloro-3-methylidenecyclopentanol		
17.	cyclohexane-1,3,5-triol	**18.**	cyclohexane-1,3-diol
19.	cyclopenta-1,3-diene	**20.**	(6*E*)-oct-6-en-1-yne
21.	but-1-en-3-yne	**22.**	(3*Z*)-pent-3-en-1-yne
23.	buta-1,3-diyne	**24.**	(2*E*)-dec-2-en-5-yne
25.	(6*Z*)-dodec-6-en-2-yne	**26.**	pent-1-en-4-yne
27.	4-ethynyl-1-methylcyclohexene	**28.**	cyclooctyne
29.	(2*E*)-hex-2-en-4-yne	**30.**	5-ethynylcyclopenta-1,3-diene
31.	5-(prop-2-enyl) cyclopenta-1,3-diene		
32.	3,5-dibromo-2-chloro-4-ethenylcyclohexanol		
33.	cyclopropylmethyl cyclobutanecarboxylate		
34.	cyclobutylmethyl cyclopropanecarboxylate		
35.	ethyl ethanoate	**36.**	2-methylpropyl butanoate
37.	prop-2-enyl 3-ethylpent-4-enoate	**38.**	4-methylpentan-2-one
39.	2,5-dimethylheptan-3-one	**40.**	octa-1,7-dien-4-one
41.	3,4-dimethylheptane-2,6-dione	**42.**	9-ethyl-3-methylundecane-2,5,10-trione

43.	5-methyloctanal	**44.**	but-3-enal
45.	3-ethylheptanal	**46.**	*N*,3-dibromobutanamide
47.	4-chloro-*N*-(3-chlorobutyl)butanamide		
48.	3-bromo-*N*-(2-bromoethyl)-4-chloropentanamide		
49.	*N*,3-diethyl-*N*-propylpentanamide		
50.	3-cyclopropyl-*N*-(3-cyclopropylbutyl)pentanamide		
51.	4-bromo-*N*-(3-bromo-2-chloropropyl)-3-chloropentanamide		
52.	3-bromo-4,5-dichloro-*N*-(2-chloroethyl)hexanamide		
53.	(5*E*)-*N*-(prop-2-en-yl)oct-5-enamide		
54.	3-chloro-*N*-(2-cyclopentylpropyl)-4-cyclopropylpentanamide		
55.	5,6-dibromo-3,4-dichloro-*N*-(2-chloroethyl)heptanamide		
56.	3-bromo-*N*-(3-bromobutyl)butanamide		
57.	3,4-dibromo-*N*-(3,4-dibromobutyl)pentanamide		
58.	4-bromo-*N*-(3-chloro-2-cyclopropylpropyl)-3-(cyclopenta-2,4-dien-yl)butanamide		
59.	2-oxopropanal	**60.**	4-oxopentanal
61.	3-oxobutanal	**62.**	3,4-dicyclopropyloct-7-yn-2-one
63.	(2*E*,6*E*)-4-bromo-5-chloro-8-cyclopropyl-10-oxodeca-2,6-dienoic acid		
64.	4,5,6,7,8,9-hexaethynyldodec-11-ynoic acid		
65.	(2*E*,6*E*)-5,9-dibromo-4-cyclopropyl-6-formylundeca-2,6-dienoic acid		
66.	3-bromo-5-chloro-6-(formylamino)hexanoic acid		
67.	ethyl 3-phenylpropanoate	**68.**	ethyl methyl benzene-1,3-dicarboxylate
69.	ethenylbenzene	**70.**	benzoyl chloride
71.	methyl 4-acetyl-2-nitrobenzoate	**72.**	2-formyl-4-sulphobenzoic acid
73.	1,2-dibromo-4-chlorobenzene	**74.**	octylbenzene
75.	2-bromo-1-chloro-4-nitrobenzene	**76.**	4-formyl-2-sulphobenzoic acid
77.	3-(trichloromethyl)benzoic acid	**78.**	4-(ethoxycarbonyl)benzoic acid

79.	4-ethenylbenzoic acid	**80.**	4-benzylbenzoic acid
81.	biphenyl	**82.**	1,2,5-tribromo-3,4,6-trichlorobenzene
83.	ethyl 4-acetylbenzoate	**84.**	2-bromo-6-chlorophenol
85.	2, 4, 6-tribromophenol	**86.**	ethyl 4-bromo-3-chlorobenzoate
87.	ethyl 3-chloro-4-mercapto/sulpho benzoate	**88.**	ethyl 4-(chlorocarbonyl)benzoate
89.	3-bromo-4-sulphobenzaldehyde	**90.**	benzene-1, 3-dicarbaldehyde
91.	4-bromo-2-chlorobenzaldehyde	**92.**	1-phenylpentan-1-one
93.	1-(3-bromophenyl)hexan-1-one		
94.	4-bromo-1-(3-bromo-4-chlorophenyl)pentan-1-one		
95.	1-(3-bromo-5-chlorophenyl)-2-chloroethanone		
96.	1-(3-nitrophenyl)ethanone	**97.**	2,4-dinitrobenzoic acid
98.	methylcyclohexane carboxylate	**99.**	2-methylcyclopentane carboxamide
100.	methyl-2-bromocyclohexane carboxylate	**101.**	2-(2-methylcyclobut-1-enyl)ethanal
102.	4-formyl-2-oxocyclohexane-1-carboxylic acid		
103.	5-cyclohexyl-6-hydroxy-5-methylhex-3-en-1-oic acid		
104.	2-oxocyclohexane-1-carboxylic acid	**105.**	ethyl-2-oxocyclohexane-1-carboxylate
106.	*N*-methylmethanamide	**107.**	2-bromo-4-chloro-5-ethynylcyclohexanol
108.	2-bromo-6-chloro-3-methylidene-cyclohexanol		
109.	*N*-phenylcyclohexane carboxamide	**110.**	cyclohexane carbonitrile
111.	cyclopentanecarbaldehyde	**112.**	cyclohexanecarboxamide
113.	2-bromo-6-methyl-cyclohexanecarbaldehyde		
114.	cyclopropane carboxylic acid		
115.	4-cyno-2-hydroxy-5-nitrocyclohexane carboxylic acid		
116.	6-chloro-5-cyno-4-nitrocyclohex-2-ene carboxylic acid		
117.	6-chloro-4-(3-oxo cyclobutyl)cyclohex-2-ene carboxylic acid		
118.	4-(2-amino-4-hydroxycyclopentyl cyclohex-2-enecarboxylic acid		

119.	cyclohexylidenemethanone	**120.**	2-bromo-4-chloro-1-methylbenzene
121.	1,2-diethyl-3-methyl-4-propylbenzene	**122.**	1-ethyl-3-nitrobenzene
123.	2-methyl-1, 3, 5-trinitrobenzene	**124.**	1-methyl-3-nitrobenzene
125.	Diphenylmethane	**126.**	4-Methyl-3-nitrobenzene sulphonic acid
127.	1-ethenyl-4-methylbenzene	**128.**	heptan-3-amine
129.	2-methylpentan-3-amine		
130.	**(a)** 2,11-dimethyltridecane		
	(b) 12-methyl-tridecan-3-ol		
	(c) 4-ethyl-3-methyloctane		
	(d) 1,2,7-trimethylcyclopentadecane		
	(e) 1,1,2,5-tetramethylcyclopentane		
131.	**(a)** 5-isobutyl-2-methylnonane, 5-2-methylnonane (2-methylpropyl)		
	(b) 2,7-dimethyl-4-propyloctane		
	(c) 6-(2,3-dimethylbutyl) 3-methyl undecane		
	(d) 1,1,2,6-tetramethylcyclohexane		
	(e) 2,2,3-trimethylcyclohexanol		
	(f) 1,2,4-trimethylcyclopentane		
	(g) 2-methylbicyclo[3.1.1] heptane		
	(h) 2-methylbicyclo[3.1.1] heptane		
	(i) 2,2,6,6,7-pentamethyloctane		
	(j) 4-(1methylpropyl)-2,3,5-trimethyl nonane **Not** 2-butyl		
	(k) 5-(1-ethyl-2-methyl-1-(1-methylethyl)propyl) nonane		
132.	a - r; b - s; c - q; d - p		
133.	a - q; b - p; c - s; d - r		

Subjective Problems

1. 4